"A PROSPECTIVE, RANDOMIZED STUDY COMPARING BUPIVACAINE AND LEVOBUPIVACAINE THROUGH ULTRASOUND GUIDED SUPRACLAVICULAR BLOCK IN PATIENTS UNDERGOING ELECTIVE UPPERLIMB SURGERIES"

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in partial fulfilment for the award of the degree of
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IN
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CERTIFICATE

This is to certify that the dissertation entitled, " A prospective, Randomized study comparing bupivacaine and levobupivacaine through ultrasound guided supraclavicular block in patients undergoing elective upperlimb surgeries"submitted by Dr. HAMILTON.J.N.C in partial fulfilment for the award of the degree of doctor of medicine in anaesthesiology by The tamilnadu Dr. M.G.R Medical University, Chennai is bonofide record of the work done by him in the INSTITUTE OF ANAESTHESIOLOGY & CRITICAL CARE, Madras Medical College, during the academic year 2012-2015.

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DECLARATION

I hereby declare that the dissertation entitled, “A prospective, Randomized study comparing bupivacaine and levobupivacaine through ultrasound guided supraclavicular block in patients undergoing elective upperlimb surgeries” has been prepared by me under the Guidance of **Prof.Dr.D.Ganthimathi, M.D., D.A.,** Professorof Anaesthesiology, Institute of Anaesthesiology and Critical Care, Madras Medical College, Chennai, in partial fulfilment of the regulations for the award of the degree of doctor of medicine in anaesthesiology, examination to be held on April 2015.

This study was conducted at Institute of Anaesthesiology and Critical Care, Rajiv Gandhi Govt. General Hospital, Madras Medical College, Chennai.

I have not submitted this dissertation previously to any university for the award of any degree or diploma.

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CONTENTS

ABSTRACT

BACKGROUND & AIMS: Levobupivacaine is a pure S-enantiomer of bupivacaine and it has similar anaesthetic profile with racemic bupivacaine but reduced toxic potential.

We conduct the present study to evaluate and compare the intraoperative haemodynamics and onset and duration of sensory and motor blockade.

METHODS: After clearance from ethics committee, single blinded randomized study carried out on ASA-PS I & II patients, undergoing elective upper limb surgeries under supraclavicular block, were randomly assigned two groups

GROUP A – supraclavicular block with 0.5% Bupivacaine (0.4ml/Kg)

GROUP B – supraclavicular block with 0.5% Levobupivacaine (0.4ml/Kg)

RESULTS: The duration of sensory and motor blockade was prolonged with levobupivacaine. The onset of sensory and motor blockade and intraoperative haemodynamics were same as bupivacaine. Complete failure and toxicity were not reported in both groups.

CONCLUSION: Levobupivacaine is safer and longer acting local anaesthetic and its clinical profile is similar to racemic bupivacaine with reduced toxicity.

INTRODUCTION

Peripheral nerve blocks provide ideal operating condition when used in optimal conditions. They reduce the stress response and least interfere with the vital physiological functions of the body compared to conventional techniques. Adequately administered regional anaesthesia not only provide excellent intraoperative pain relief but also give best post operative analgesia.

When we trace regional anaesthesia origin, Dr. Carl Koller, a young ophthalmologist, employed a cocaine solution for topical corneal anaesthesia in patients undergoing eye surgeries in 1884. Most of the local anaesthetic agents developed in the first half of twentieth century (1900-1940) were basically ester compounds. They lost their importance due to their short duration of action, systemic toxicity and associated allergic reactions. These paved the way for the synthesis of newer agents namely amide type of local anaesthetic agents.

Brachial plexus block was first performed by William Stewart Halsted[1] in 1889. He directly exposed the brachial plexus in the neck to perform the block using cocaine. Hirschelfirst performed

the percutaneous approach of brachial plexus block. Kulenkampf was the first to perform the classical supraclavicular approach to the brachial plexus block. Then Winnie and Collins introduced the subclavian perivascular block. Raj was the first to perform the brachial plexus block through infraclavicular approach. Accardo and Adriano first to introduce the axillary approach.

On subsequent days, regional blocks have been performed using nerve stimulation, anatomical landmarks and of fascia clicks. Blind blocks that rely solely on anatomical landmarks are known to produce serious complications. Even the nerve stimulation technique, recommended as the gold standard for nerve identification in regional blocks over the past decade fails to ensure an adequate level of nerve block. It also carries a risk of damage to nerve structures by direct puncture.

Ultrasound visualisation of anatomical structures offers safe block of superior quality by optimal needle positioning. La Grange and colleagues in 1978 were the first to perform the supraclavicular block through ultrasound blood flow detector. Stephen kapral et al in 1994 published the first reported use of direct sonographic visualisation for regional anaesthesia. However dramatic progress has been madeover the past ten years.

The present study was designed to compare ultrasound guided supraclavicular block using bupivacaine andlevobupivacaine in patients undergoing elective upper limb surgeries.

AIM OF THE STUDY

To compare ultrasound guided supraclavicular block using bupivacaine or levobupivacaine in patients undergoing elective upperlimb surgery with respect to,

1) Intra operative hemodynamics ,

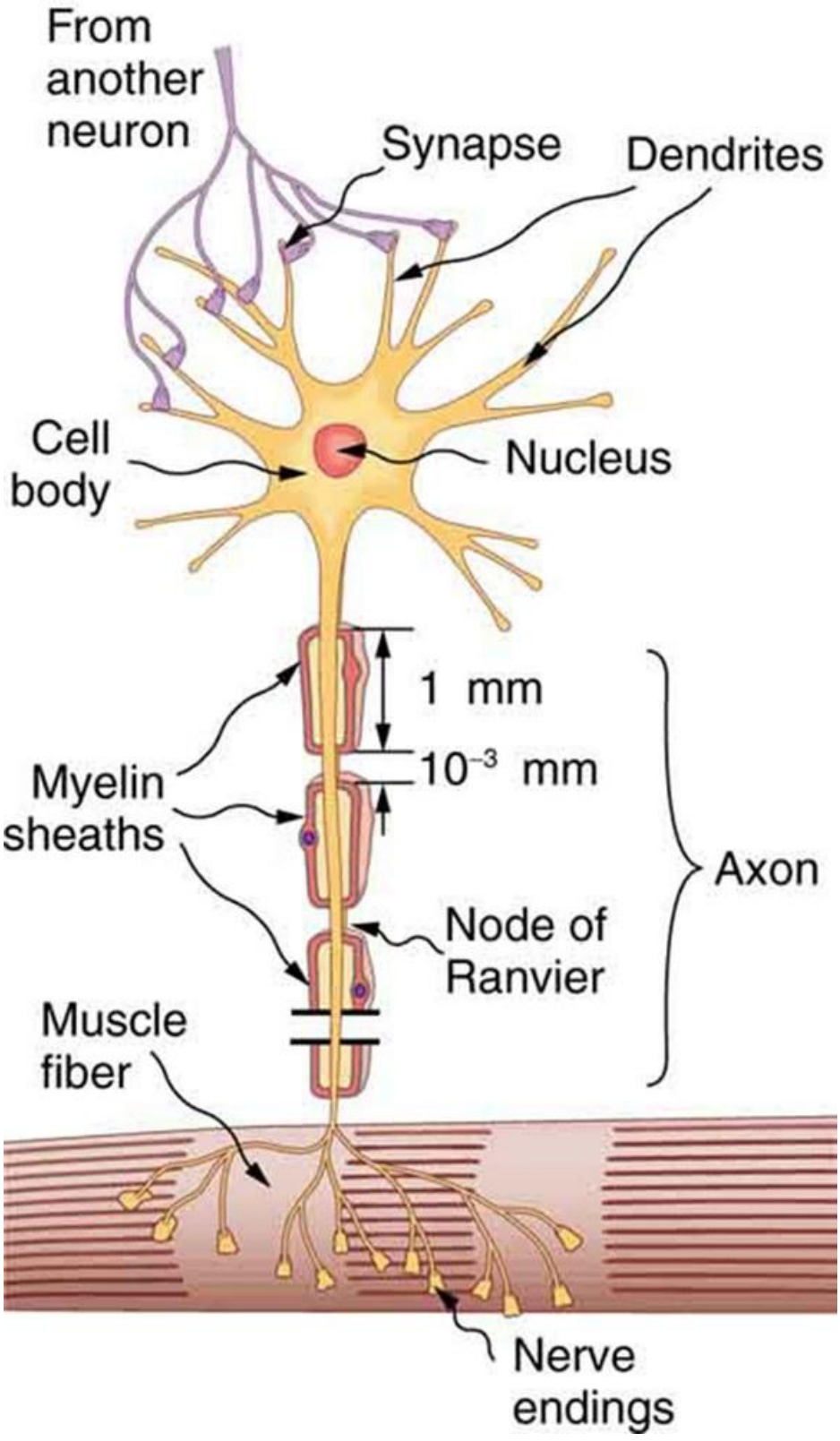
2) To compare onset and duration of sensory and motor blockade

PHYSIOLOGY OF NERVE CONDUCTION

The human nervous system consists of billions of neurons and supporting cells(neuroglial-astrocytes, oligodendrocytes and microglial cells for central nervous system and Schwann cells for peripheral nervous system). Neurons are able to respond to stimuli (such as touch, sound, light and so on), conduct impulse and communicate with each other (and with other types of cells like muscle cells).

The nucleus of a neuron is located in the cell body. Extending out from the cell body are processes called dendrites and axons. These processes vary in number and relative length but always serve to conduct impulses.

ANATOMY OF NERVES[2]



Each nerve contains both afferent and efferent nerve fibers .They are bundled into one or more fascicles and organized within three tissue layers:epineurium, perineurium, endoneurium. Individual nerve fiber is surrounded by endoneurium, each fascicle surrounded by perineurium and finally epineurium encases group of fascicles. These three layers act as barriers to passive diffusion of local anaesthetics.

Each nerve fiber is differentiated by presence or absence of myelin sheath. Myelinated nerve fiber are surrounded by Schwann cells in peripheral nervous system and by oligodendrocytes in the central nervous system. The myelin sheath is not a continuous sheath, it is interrupted at short, regular intervals by specialized regions called nodes of Ranvier. Nerve impulse conduct in myelinated nerve fibers by saltatory conduction.

Nerve fibers are classified according to their size, velocity , function and local anaesthetic susceptibility.

SODIUM ION CHANNEL

Sodium channels are integral membrane proteins which conduct sodium ions through a cell’s plasma membrane. They are classified according to the trigger that opens the channels either

voltage change (voltage gated) or binding of substance (ligand gated) to the channel.

Sodium channel consists of a large α subunit and a small β subunit. The α subunit has four domains (D1 – D4), each containing six membrane spanning segments, labelled S1 through S6. The S4 segment act as voltage sensor. The extracellular portion of pore is formed by S5 and S6, which is the most narrow part of the channel and is responsible for ion selectivity. The intracellular portion of the pore is formed by S6 segment of the four domains. The region linking domains 3 and 4 is important for inactivating the channel.

Sodium channel can exist in any three distinct states:deactivated (closed), activated (open) and inactivated (closed) .

REFRACTORY PERIOD[3]

Refractory period of a cell is the period of time during which the cell cannot respond to further stimuli.It is divided into two types-absolute refractory period and relative refractory period.

Absolute refractory period is one during which a second stimulus (no matter how much strong stimulus) cannot produce

second action potential. Its duration is typically just a millisecond or less. It corresponds to depolarisation and part of repolarisation.

Relative refractory period is one during which a second stimulus (if the stimulus is greater than the threshold potential) can produce action potential. Its duration is several milliseconds. It corresponds to the remaining part of repolarisation and hyperpolarisation.

ALL OR NONE LAW

It is a principle which states that a muscle or nerve fibre either responds completely (when the stimulus is above the threshold potential) or none at all. Amplitude of the response does not depend on the strength of stimulus

ELECTROPHYSIOLOGY

RESTING MEMBRANE POTENTIAL (RMP)

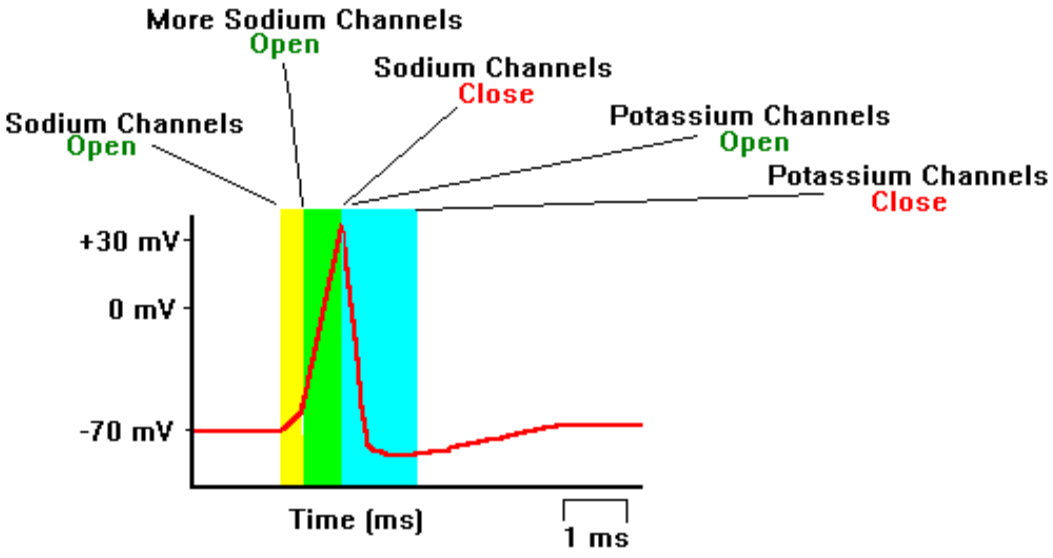
Transmission of electric nerve impulse along the cell membrane forms the basis of signal transduction along nerve fiber. Resting membrane potential means unequal distribution of ions on the two sides of the nerve cell membrane.The resting membrane potential is approximately -60 to -70mV in neurons (the

extracellular electric potential is by convention taken as zero). It is maintained by

1) Difference in intra and extracellular concentration of sodium and potassium which is maintained by active Na-K pump.

2) Increased permeability of potassium ions compared to sodium ions (potassium leak).

ACTION POTENTIAL



An action potential is a very rapid change in membrane potential that occurs when a nerve cell membrane is stimulated. When a stimulus, above the threshold level, reaches the nerve cell membrane, it causes the ions move back and forth to raise the

resting membrane potential (-70mV) to more positive values (+30mV) in a few milliseconds to produce action potential.

The sequences of action potential are as follows

1) When a stimulus (chemical or electrical) reaches the nerve cell membrane , it causes some sodium channels to open so that resting membrane potential reaches the threshold level (generally 5 – 15 mV less negative than resting potential). But the stimulus should be above the threshold stimulus.

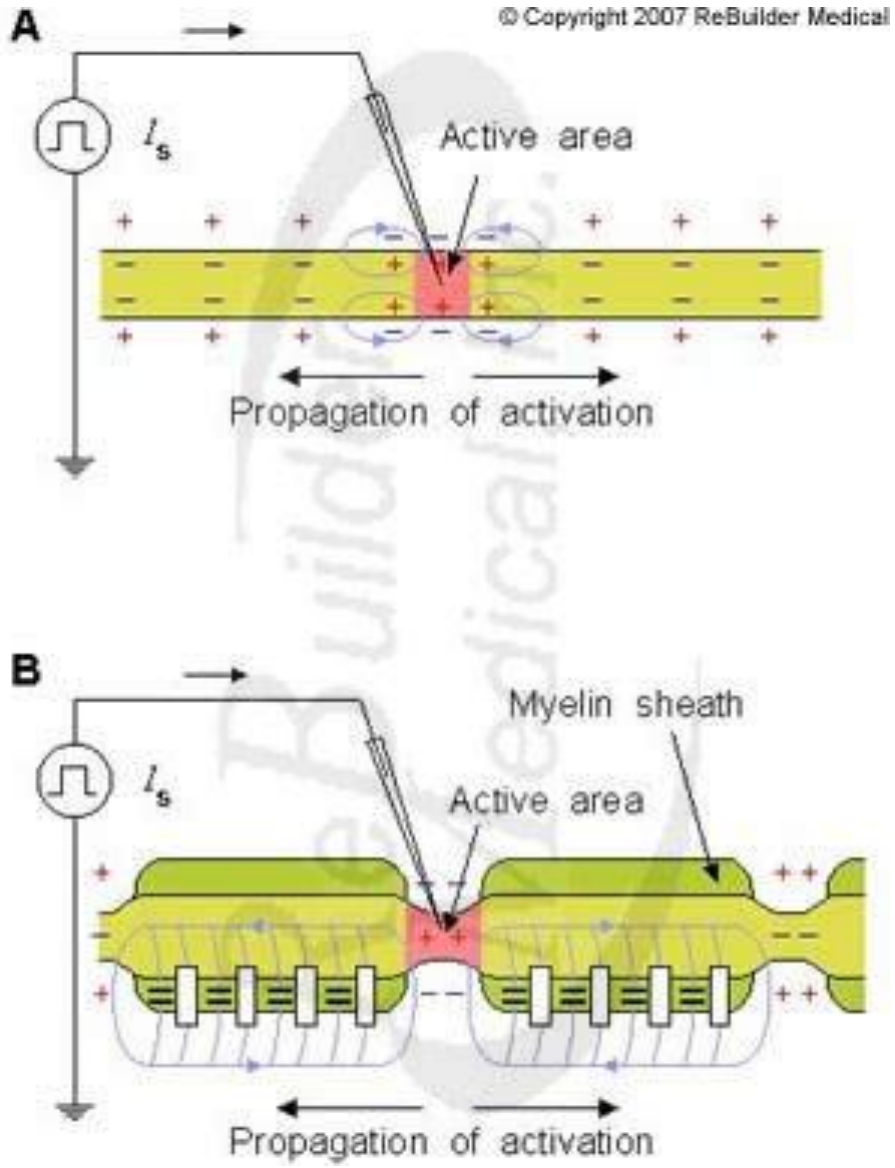
2) When nerve cell membrane reaches the threshold level , it causes more sodium channels to open allowing more sodium ions rush into the cell so that the charges across the the membrane completely reverse . By which the threshold level reaches peak level (-55mV to +30).

3) The peak level voltage of the action potential causes the gated sodium channels to close and potassium channels to open. Potassium ions move outside the membrane and sodium ions stay inside the cell membrane to repolarize the cell.

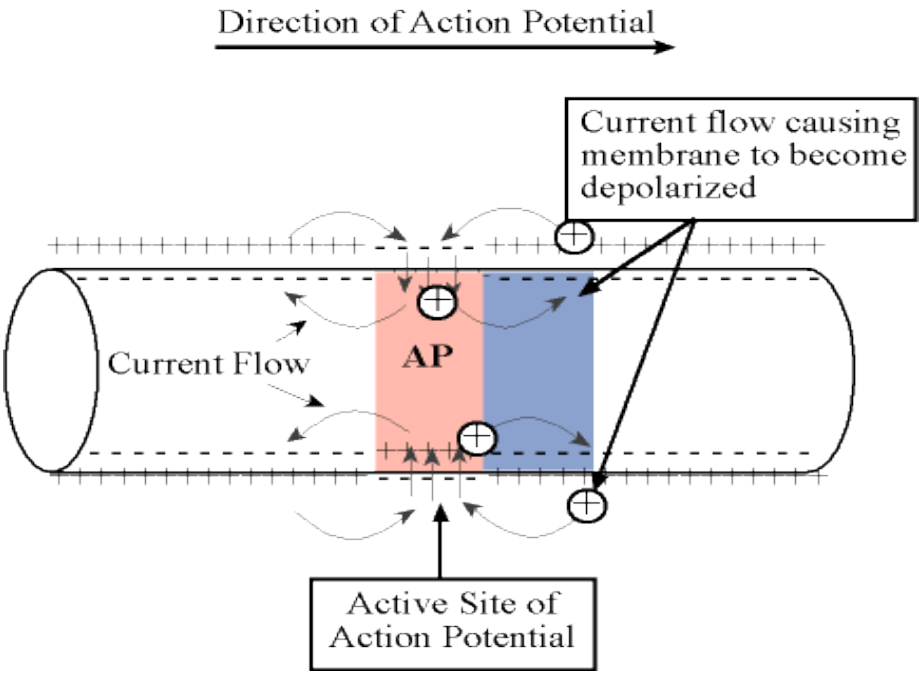
4) Due to more repolarization the neuron enters hyperpolarized state. In this state more potassium ions are on outside than

sodium ions are on inside. this causes cell's potential to drop slightly lower than the resting potential.

5) Finally neuron's sodium-potassium pump goes back to work which causes three sodium ions push outside the membrane and two potassium ions pull inside the membrane so that neuron reaches the resting potential.



IMPULSE CONDUCTION



An impulse is simply the movement of action potential along the neuron cell. When action potential occurs, the particular area is depolarized. As a result, adjacent areas have opposite charges which means depolarized areas have more positive charges on inside and negative charges on outside the membrane where as adjacent areas have more negative charges on inside and positive charges on outside the membrane. It develops a mini circuit on the membrane between these oppositively charged areas. In other words electron flow between these areas. The process repeats itself , action potential reaches the end bulb.

Conduction velocity depends upon the diameter of fiber and the presence or absence of myelin. Speed of conduction is 1 to 120

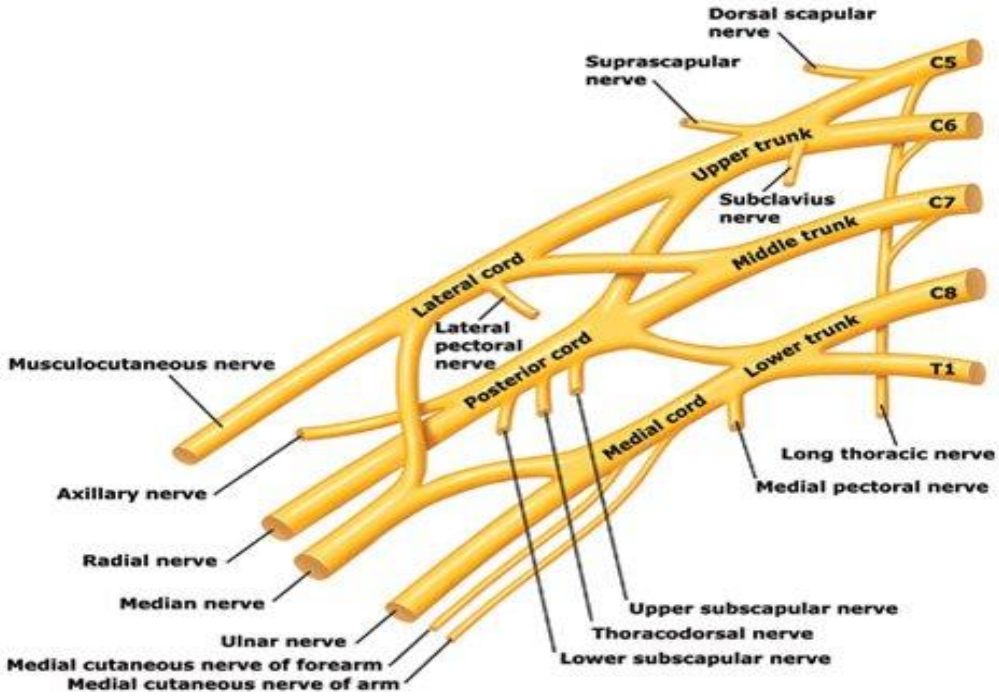
meters per second. Myelinated fibers conduct the impulse more faster than non myelinated fibers.

In myelinated nerve fibers ions can pass only through nodes of Ranvier as it lacks myelin which acts as insulator preventing ion movement in the rest of the nerve fibre. This results in jumping of action potential from one node of Ranvier to another node only. These process is called ‘saltatory conduction’.

IMPULSE TRANSMISSION

When an action potential reaches the end bulb, the membrane become more permeable to calcium ions. Calcium influx causes vesicles move toward the synaptic cleft. Vesicles fuses with pre synaptic membrane and release their neurotransmitter (process called exocytosis). Neurotransmitter gets attached to its receptor on the post synaptic membrane and produce the response. If enough neurotransmitter is released or enough sodium ions enter into the cell, action potential will propagate over post synaptic membrane. Of course, if insufficient neurotransmitter is released, action potential will not be propagated. The neurotransmitter are then quickly taken back into presynaptic terminal via transporters or destroyed by the enzymes in the synaptic cleft.

ANATOMY OF BRACHIAL PLEXUS[4]

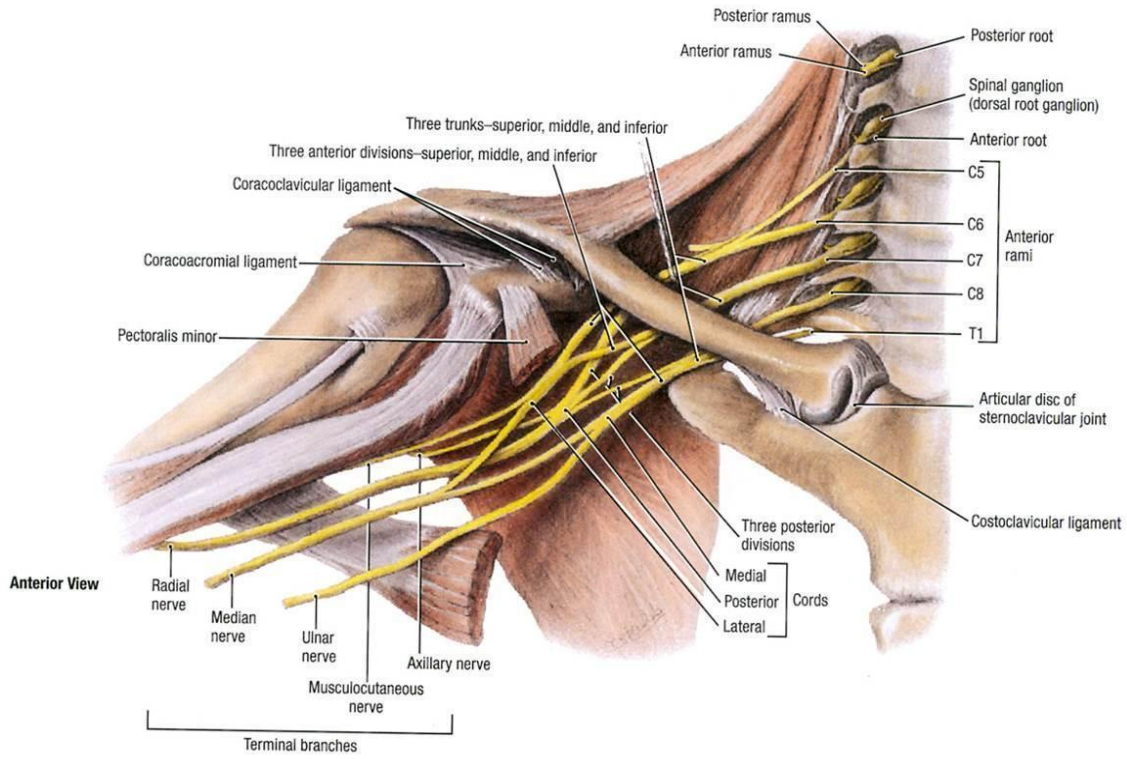


The brachial plexus contributes both motor and sensory supply of the upperlimb. So brachial plexus has been called as 'spinal of the arm'.

The brachial plexus is mainly derived from the ventral rami of lower four cervical nerves (C5 – C8) and first thoracic nerve roots (T1). Approximately 15% of patients the plexus is mainly derived from C4 – C8 which is called as '*prefixed plexus'* or from C6 – T2 which is is called as '*postfixed plexus'*. These variations are usually associated with presence of cervical rib or an anomalous first rib.

The brachial plexus is divided into five parts. There are ***Roots, Trunks, Divisions, Cords and Branches.*** There are five terminal branches – musculocutaneous nerve , axillary nerve , ulnar nerve , median nerve and radial nerve. There are some preterminal and collateral branches which leave along its length at various points.

The nerve roots of the plexus typically comprise a large fascicle. These then become polyfascicular due to division and recombination along the full length of plexus. Simply, the number of fascicle increases and their cross sectional area decreases, from proximal to distal in the plexus.



ROOTS

The anterior rami of C5,C6,C7,C8 and T1 forms the ‘roots’ of the plexus. These five spinal nerves exit from the intervertebral foramina and lie on a sulcus in the respective vertebral transverse process . This sulcus is present between anterior and posterior tubercle which gives origin to anterior and medial scalene muscle respectively.

The dorsal scapular nerve arise from C5 root which supplies rhomboids muscle. The long thoracic nerve (also called nerve of Bell) arise from C5 ,C6 and C7 roots which supplies to serratus anterior musle.

TRUNKS

The five nerve roots unite to form three nerve trunks – upper , middle and lower . The upper two nerve roots (C5 & C6) unite to form upper trunk , C7 root continues as middle trunk and the lower nerve roots (C8 & T1) unite to form lower trunk. The five roots travel in anterior and medial direction and then become sandwiched between scalenus anterior and medius to form three trunks.

The nerve to subclavius and suprascapular nerve arise from upper trunk. The suprascapular nerve contributes sensory

innervations to shoulder joint and motor innervations to supraspinatus and infraspinatus muscles.

DIVISIONS

At the lateral border of first rib each trunk bifurcates into anterior and posterior divisions. It is situated posterior to the clavicle. Generally anterior division supply flexor muscles or ventral aspect of upper limb while posterior division supply extensor muscles or dorsal aspect of upperlimb.

CORDS

The anterior division of upper and middle trunk unite to form lateral cord, the anterior division of lower trunk forms medial cord and the posterior division of all three trunks unite to form posterior cord. The cords are labelled according to their relationship with axillary artery behind the pectoralis minor muscle.

BRANCHES

The lateral cord gives three branches – Lateral part of median nerve , Musculocutaneous nerve , Lateral pectoral nerve.

The medial cord gives five branches – Medial part of median nerve , Medial cutaneous nerve of arm , Medial cutaneous nerve of forearm , Medial pectoral nerve and ulnar nerve.

The posterior cord gives important five branches – Upper subscapular nerve , Lower subscapular nerve , Nerve to latissimus dorsi (thoracodorsal nerve) , Axillary nerve and Radial nerve.

THE RELATIONS OF THE BRACHIAL PLEXUS

ROOTS

The roots of the brachial plexus emerge from intervertebral foramina and lie in the sulcus between anterior and posterior tubercles and then it lies between scalenus anterior and medius muscle. It lies above the second part of subclavian artery.

TRUNKS

In the neck, the brachial plexus lies in the posterior triangle which is bordered by clavicle , sternocleidomastoid muscle and trapezius muscle. It is covered by skin, platysma and deep fascia. It is crossed by supraclavicular nerves, inferior belly of omohyoid, external jugular vein and transverse cervical artery.

The upper and middle trunk lie above the subclavian artery but the lower trunk lie behind the artery. These three trunks may groove the first rib immediately posterior to the subclavian groove.

THE INTERSCALENE SHEATH

As the roots emerge between the transverse process tubercles, they lie in a fibrofatty space between two layers of fibrinous sheath. Anterior and posterior tubercle is the origin for scalenus anterior and medius respectively. Posterior part of the sheath arise from posterior tubercle and covers the front of scalenus medius while the anterior part of sheath arise from anterior tubercle and covers the posterior aspect of scalenus anterior. The sheath extends into the axilla around the plexus. Significance of this space is that the local anaesthetic can be injected at various sites by interscalene, subclavian perivascular or the axillary approach.

SUMMARY

The composition of brachial plexus can be summarized as follows

1) Branches from the roots

   a. Nerve to the serratus anterior

b. Twig to phrenic nerve

c. Dorsal scapular nerve

2) Branches from trunks

a. suprascapular nerve

b. nerve to subclavius

3) branches from cords

a. A)lateral cord

b. lateral pectoral nerve

c. musculocutaneous nerve

d. lateral head of median nerve

4) B)medial cord

a. medial pectoral nerve

b. medial cutaneous nerve of arm

c. medial cutaneous nerve of forearm

d. medial head of median nerve

e. ulnar nerve

f. posterior cord

   i. upper subscapular nerve

   ii. lower subscapular nerve

   iii. nerve to lattisimus anterior

   iv. axillary nerve

   v. radial nerve

PHARMACOLOGY OF BUPIVACAINE AND LEVOBUPIVACAINE[5]

Bupivacaine and Levobupivacaine are amide type of long acting local anaesthetic agents. They block nerve conduction in sensory and motor nerves largely by interacting with voltage sensitive sodium channels on the cell membrane,though potassium and calcium channels are also blocked.

The dose of levobupivacaine is expressed as base whereas the dose of racemate bupivacaine is expressed as hydrochloride salt. This gives rise to approximately 13% more active substance in levobupivacaine solutions compared to bupivacaine.

STRUCTURE

Bupivacaine is piperidinecarboxamide 1-butyl – N(2,6dimethyl phenyl) monohydrochloride , a white odourless, crystalline powder that is freely soluble in water. It is homologue of mepivacaine (addition of butyl group to the piperidine nitrogen of mepivacaine results in bupivacaine) and is chemically related to lidocaine..

Bupivacaine is chiral drug which has asymmetric carbon atom which exhibits a stereoisomerism. Bupivacaine is racemic mixture

of both S and R enantiomers (50:50 mixture) where as Levobupivacaine is the S enantiomer of bupivacaine. So levobupivacaine has less neurotoxicity and cardiotoxicity than bupivacaine.

MECHANISM OF ACTION

Local anaesthetics block the generation and conduction of the nerve impulse presumably by

- Increasing the threshold for electrical excitation in the nerve
- Slowing the nerve impulse propagation
- Reducing the rate of rise of action potential

At cellular level, local anaesthetics block sodium conductance by

- Binding of local anaesthetics to internal gate (H gate) on sodium channels at inactivated closed state to prevent opening of the channels by inhibiting the conformational changes
- They produce nonspecific membrane expansion which means unfolding of membrane protein with consequent obstruction of sodium channel.

In general, the action of local anaesthetic is related to

- ❖ Diameter of the nerve fibre
- ❖ Myelination status of the nerve
- ❖ Conduction velocity

The order of loss of nerve function is as follows

- Pain
  - Temperature
    - Touch
      - Proprioception
        - Skeletal muscle tone

Properties	Lignocaine	Bupivacaine	Levobupivacaine
Potency	1	4	4
Onset	RAPID	SLOW	SLOW
pK	7.9	8.1	8.1
Protein Binding	70	95	>97
Lipid Solubility	2.9	28	28
Vd	91	73	55
Duration in PNB	60-180	240-960	840-1020

PHARMACOKINETICS

A local anaesthetic pharmacokinetic parameters can be significantly altered by

- Presence of hepatic or renal disease
- Addition of epinephrine
- Factors affecting urinary pH
- Renal blood flow
- Route of drug administration
- Age of the patient

ABSORPTION

The rate of systemic absorption of local anaesthetic is dependent upon

- Dose
- Concentration
- The route of administration
- Vascularity of administration site
- Presence or absence of epinephrine

METABOLISM

Amide type of local anaesthetics are metabolized primarily in the liver by dealkylation and hydroxylation through CYP3A4 and CYP1A2 isoforms to give N-desbutylbupivacaine and hydroxylbupivacaine respectively. Other metabolic pathways includes amide hydrolysis and conjugation with glucuronic acid. Due to its basic nature, alpha1-acid glycoprotein is the binding protein whose concentration is increased in some clinical situations including postoperative trauma.

EXCRETION

Poor water solubility of these drugs limit their excretion through kidney. But their metabolites can be measured in urine after certain hours of peripheral nerve blockade.

LUNG EXTRACTION

High doses or unintentional intraarterial injection may lead to rapid entry of local anaesthetics into pulmonary circulation. This pulmonary extraction will limit the amount of drug entering into systemic circulation. But for bupivacaine and levobupivacaine pulmonary extraction process saturates rapidly. So it has limited role in these drugs.

ADVERSE REACTIONS

Bupivacaine cause some adverse reactions which may be due to overdosage, unintentional intravascular injection or slow metabolic degradation.

CVS TOXICITY

Rapid entry of local anaesthetics into systemic circulation cause depression of myocardium, decreased cardiac output, AV heart block, hypotension, bradycardia, ventricular arrhythmia including ventricular tachycardia and ventricular fibrillation and cardiac arrest. Physiological changes (such as in pregnancy) and concomitant drug theraphy (β blockers, digitalis preparations, calcium channel blockers) make patients more vulnerable to cardiotoxicity.

Levobupivacaine has less cardiotoxicity and successful resuscitation is more likely.

CNS TOXICITY

After rapid entry of local anaesthetics into systemic circulation, it readily cross the blood brain barrier due to high lipid solubility. It is characterised by depression followed by excitation,

restlessness, anxiety, dizziness, tinnitus and blurred vision. Other CNS effects include nausea, vomiting, chills and constriction of pupils.

Skeletal muscle twitching in face and extremities may proceeding to convulsion. It occurs due to inhibition of inhibitory neurons or inhibition of inhibitory neurotransmitters such as gamma amino butyric acid(GABA). CNS toxicity depends on the rate of increase of drug in systemic circulation than total amount of drug injected.

ALLERGIC REACTION

Amide type of local anaesthetics rarely cause allergic type of reaction. But ester type of local anaesthetics cause allergic reaction due to their metabolite para amino benzoic acid. Preservative in these drugs such as methyl parabene or similar substances may cause allergic reaction. But it depends on prior sensitization and antibody production.

MANAGEMENT OF LOCAL ANAESTHETIC EMERGENCIES

To avoid these toxicity, slow administration is advisable.

1) Stop the drug immediately

2) Ventilate the lungs with 100% oxygen

3) Assess the haemodynamics

4) CVS toxicity

- cardiac arrest – start CPR as per ACLS guidelines
- arrhythmia – consider antiarrythmic drugs except class Ib drugs – bretylium 20mg/kg or amiodarone 5mg/kg i.v
- AV block – conider cardiac pacing

5) CNS toxicity

Hyperventilate the lungs and administer benzodiazepines such as midazolam or diazepam i.v. If seizure persists, consider ultrashort acting barbiturate thiopentone

BASICS OF ULTRASOUND[6]

Ultrasound is the sound with frequency above 20KHz where as the audible range of frequency are 20Hz to 20KHz. For diagnostic purpose, ultrasound is used with frequency above 2MHz.

When ultrasound is propagated through medium, it creates a regular pressure variation with alternating areas of compression and rarefaction. Compression means areas of high amplitude or high pressure where as Rarefaction means low pressure zones. Ultrasound is expressed as 'sine' waves.

PROPERTIES

Wavelength: It is the distance between two areas of compression or rarefaction

Frequency: It is the number of wavelength that pass per unit time.

Propagation Velocity: It is the speed at which sound waves propagate through medium. Velocity depends on tissue density and compressibility.

$$V = \lambda f$$

λ- wavelength

f- frequency

propagation velocity of some media are

Air	–	330 ms
Water	–	1490 ms
Blood	–	1570 ms
Soft Tissue	–	1540 ms
Bone	–	4080 ms
Metal	–	5850 ms

INTERACTION OF ULTRASOUND WITH TISSUES

Ultrasound waves interact with media which are expressed as attenuation, reflection, refraction, diffraction and scattering.

Attenuation: It means absorption of ultrasound energy when it passes through medium and is converted into heat as well as reflection, refraction and scattering. When attenuation increases, penetration through medium will decrease. It is increased by

1) High frequency transducer

2) Increase acoustic impedance mismatch (less homogenous medium)

3) Increase distance from transducer

Reflection: Ultrasound waves are reflected from the medium to the transducer which forms the basis of ultrasound imaging. It depends on the difference in acoustic impedance .

Acoustic impedance depends on density (ρ) and velocity (v) of the medium.

$$Z = \rho v$$

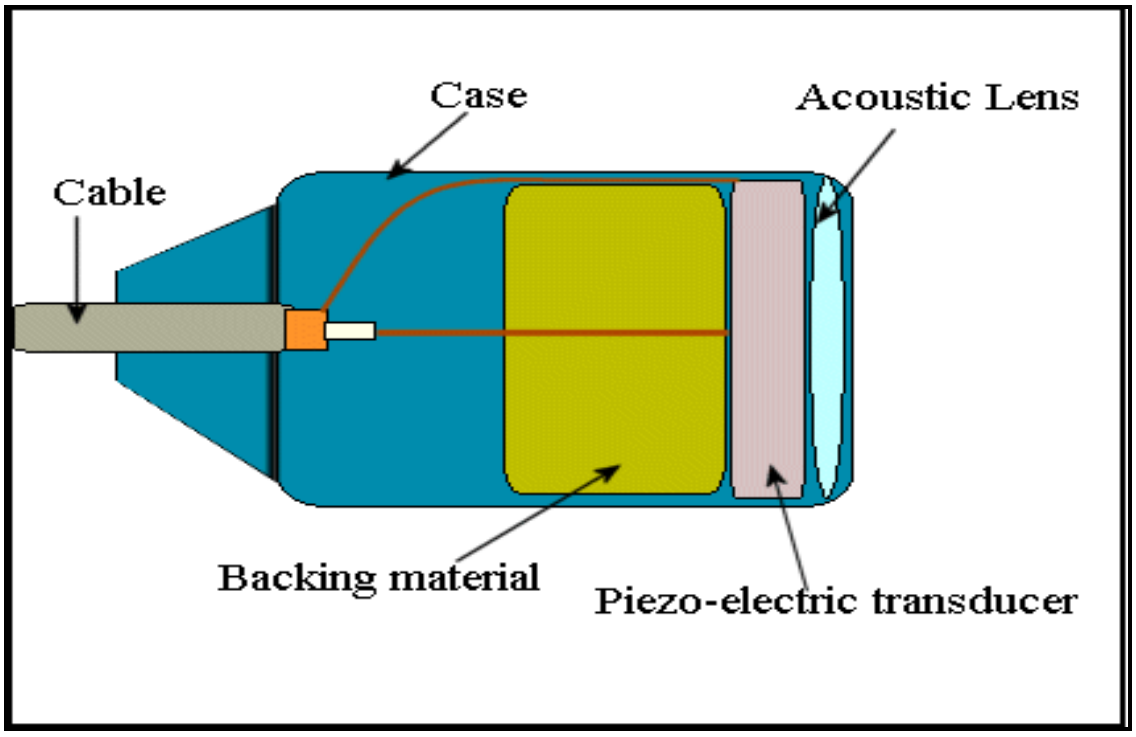
Acoustic impedance mismatch means large difference in acoustic impedance .

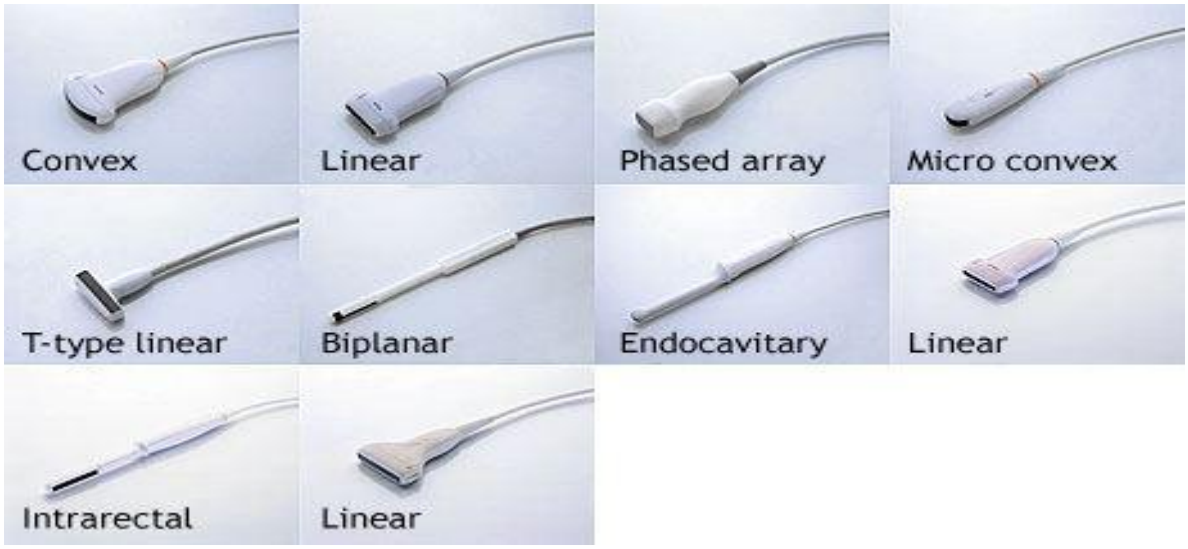
Reflection Coefficent (R) = (Z1-Z2) / (Z1+Z2)

[Z1 and Z2 are acoustic impedance of two medium]

Substances	Attenuation	Impedance
Water	0.002	1.48
Blood	0.18	1.61
Soft Tissue	0.75	1.65
Air	12	0.0001
Bone	20	8
Metal	0.2	47

TRANSDUCERS :





Ultrasound waves are generated by piezoelectric crystals. Piezoelectric means pressure-electric effect. When electric current is passed through the crystals, they change their polarity and shape of crystals which produces compression and rarefaction of ultrasound waves. The reverse is also true. The reflected echoes passed through crystals, they generate electric current and it forms the image in the screen. Hence crystals are both transmitter and receiver. The specific crystals determine the frequency of ultrasound wave.

FRESNEL AND FRAUNHOFER ZONE : Standard disc shaped transducer produces beam in cylindrical shape. The waves travel parallel to each other to some extent. It is near field or Fresnel zone. Beyond that, beam becomes divergent and reduces the resolution. It is far field or Fraunhofer zone.

RESOLUTION

Resolution means the ability to differentiate or distinguish the adjacent structures. It is divided into two types

1) Spatial resolution
    a. Axial resolution
    b. Lateral resolution
2) Temporal resolution

Axial Resolution : It means ability to distinguish the objects at slightly different depths from the transducer along the axis of the beam. It is improved by higher frequency transducer.

Axial resolution = spatial pulse length / 2

SPL = λ * no of cycles

Lateral Resolution : It means ability to distinguish the objects side by side perpendicular to the beam axis. It depends upon beam width. To optimise the lateral resolution

- ❖ Use higher frequency transducer
- ❖ Optimise focal zone
- ❖ Use minimum necessary gain

Temporal Resolution : It depends on frame rate.

ARTEFACTS

The ultrasound machine makes various assumption when it generates an image. The various types of artefacts are

- ❖ Reverberation artefact
- ❖ Side lobe artefact
- ❖ Beam width artefact

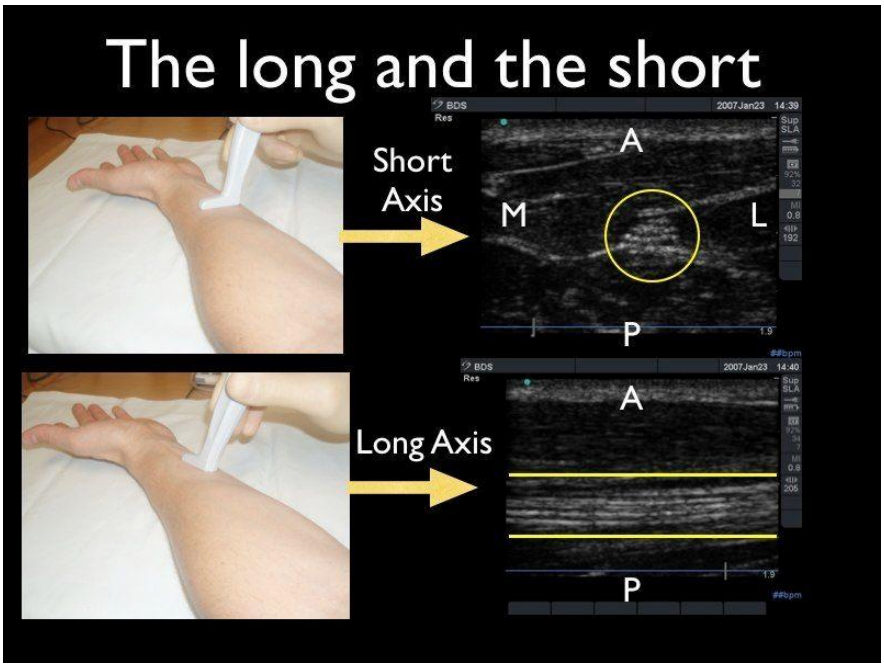
IMAGING

Short Axis Imaging

The probe is held perpendicular to the direction of target structures.

Long Axis Imaging

The probe is held along the direction of target structures.



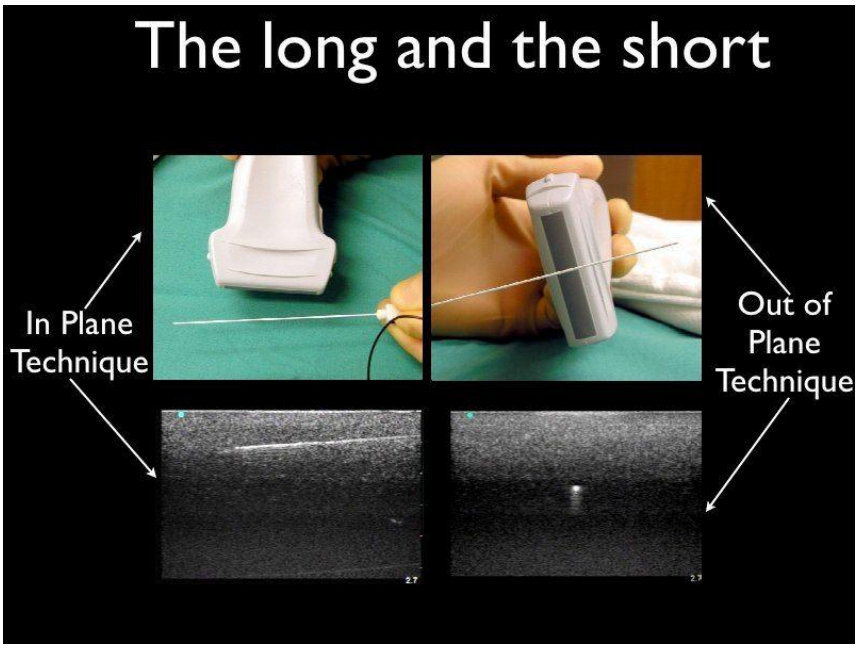
Needle Imaging

In Plane Imaging

It refers needle is directed in the same plane as ultrasound beam.

Out of plane imaging

It refers needle is directed perpendicular to the plane of ultrasound beam.



Key Components

Key components to improve needle imaging are

- ❖ In plane imaging
- ❖ Position of patient
- ❖ Low needle angle
- ❖ Make small needle movements and probe
- ❖ Hydrodissection

POTENTIAL ADVANTAGES OF ULTRASOUND GUIDANCE REGIONAL ANAESTHESIA

- Increased success rate due to direct visualisation
- Direct and indirect visualisation of spread of local anaesthesiaduring injection with the possibility of repositioning of needles in case of maldistribution of local anaesthetic
- Avoidance of inadvertent intraneural and intravascular injection
- Faster onset and longer duration of blocks
- Reduction of dose of local anaesthetic

SUPRACLAVICULAR BLOCK

Surgery of upper extremity can be achieved by various techniques of brachial plexus blockade. Brachial plexus gives number of branches along their course so that by selecting the appropriate technique, we can block the site of surgery and spare other areas. The various approaches are

1) Interscalene block

2) Supraclavicular block – classic approach, plumb bob technique, supraclavicular perivascular technique

3) Infraclavicular block

4) Axillary block

5) Peripheral block – midhumeral, elbow, wrist block

Among these techniques, supraclavicular block is simple and easy and less complicated than others. Supraclavicular block targets trunks-divisions level of brachial plexus. Typical features of this block includes rapid onset, predictability and dense anaesthesia. We can approach supraclavicular block through various techniques

1) Landmark based Supraclavicular perivascular technique

2) Nerve stimulator guided supraclavicular block

3) Ultrasound guided supraclavicular block

Indications for supraclavicular block are operation on midhumerus, elbow, forearm and hand. Distal trunk-proximal division of brachial plexus the site for supraclavicular block.

LANDMARK BASED SUPRACLAVICULAR BLOCK[7]

TECHNIQUES

After checking the emergency equipment and securing the intravenous line, intravenous fluids, ECG, pulse oxymeter, blood pressure monitor are connected.

Asepsis is done by draping the blockade site with betadine or any antiseptic solution and sterile sheath is covered on blockade site. Patient is sedated with benzodiazepines or opioid compounds.

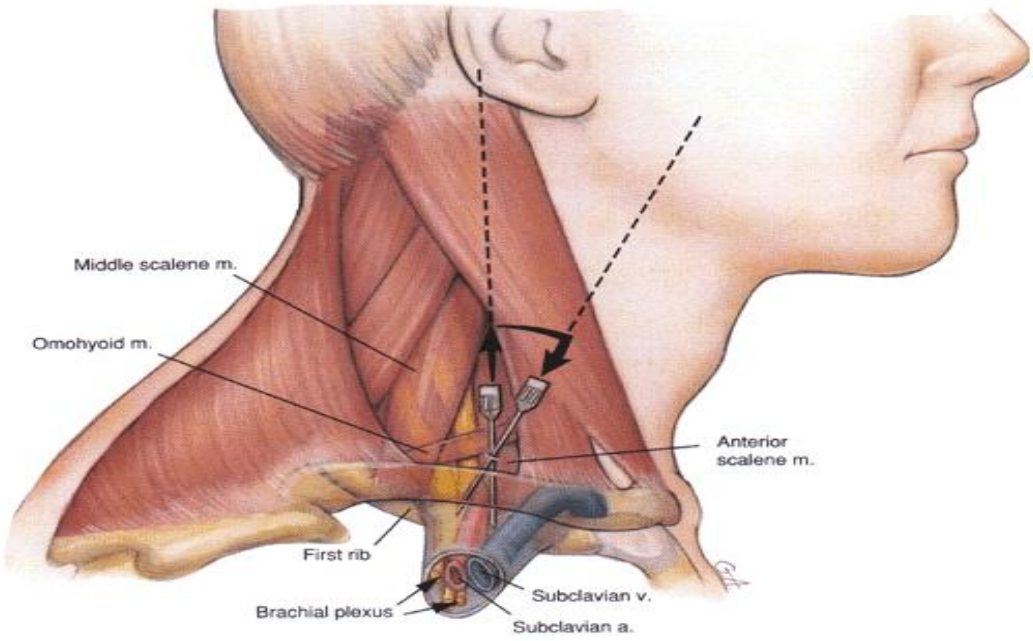
1) ***Position:*** Patient is placed in supine position and head turned 45degrees opposite to the side to be blocked. The anaesthesiologist stands behind the patient facing the arm to be blocked. The arm kept along the body with elbow flexed and hand extended and placed over the abdomen. The neck should be extended by keeping a towel behind the scapula if

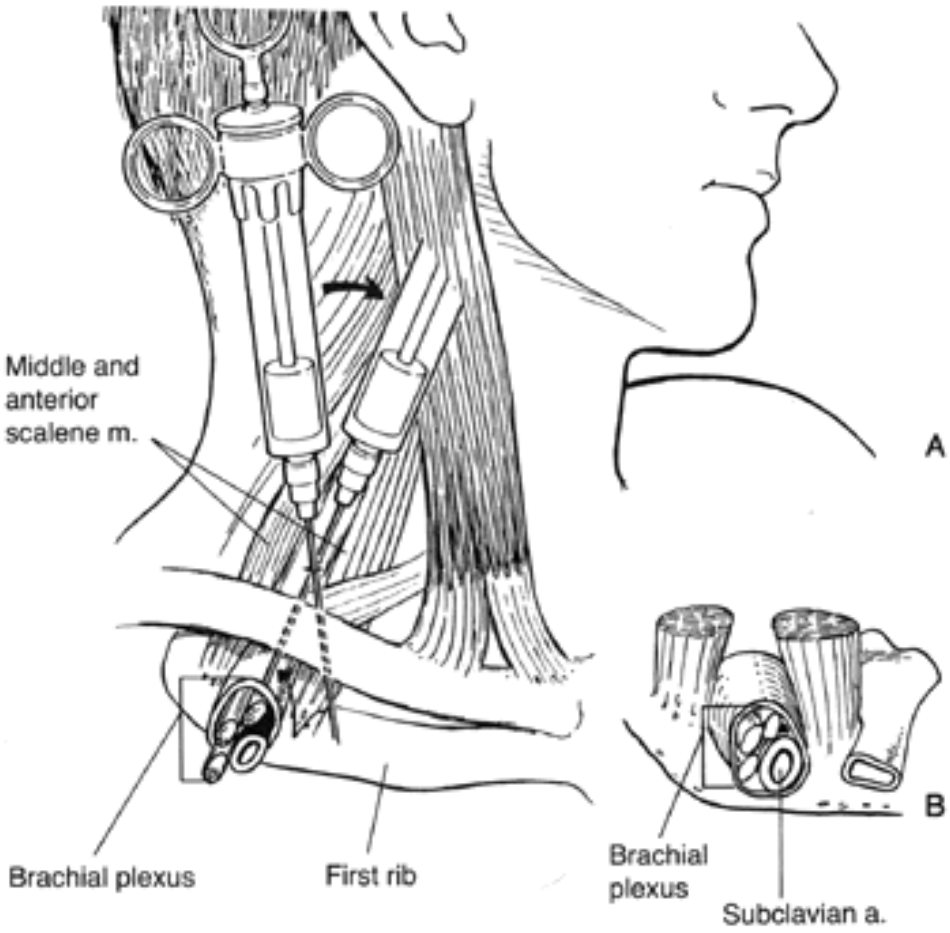
possible or elevating the patient headend by 45 degrees (semisitting position).

2) ***Identification of Groove:*** The lateral border of sternocleidomastoid muscle is palpated by asking the patient to raise the head with same turned position. Then with the palpating finger the anterior scalene muscle is rolled over to identify the interscalene groove. The scalene muscle can be identified by asking the patient to sniff. Then palpate the subclavian artery behind the clavicle and mark should be made behind the posterior border of pulsatile artery site or 1.5 to 2 cm behind the clavicle blindly.

3) ***Needling:*** First skin and subcutaneous is infiltrated with 2% lignocaine. A 22gauge, 4cm needle is directed towards inferoposterior direction with slight medial angulation. The needle should be proceeded until paraesthesia or motor response is elicited. If paraesthesia is elicited, syringe is attached and blood is aspirated before giving a local anaesthetic solution. This orientation of syringe lie parallel to the line joining needle entry site and the patient ear. Usually paraesthesia can be elicited in 35-40mm depth.

If paraesthesia cannot be elicited, redirect the needle. If rib is encountered, needle shall be walked over the rib anteriorly and posteriorly or medially with caution or laterally until paraesthesia is elicited. If artery is encountered, needle should be withdrawn and reinserted in posterolateral direction until paraesthesia is elicited. For this block 30-40ml of local anaesthetic solution is adequate.





COMPLICATIONS

1) Pneumothorax

2) Phrenic nerve block

3) Horner syndrome

4) Neuropathy

5) Haemothorax and haematoma formation

NERVE STIMULATOR GUIDED SUPRACLAVICULAR BLOCK

Nerve stimulator delivers a current (charge) to the nerve fibre eliciting motor response due to flow of ions through nerve cell membrane and initiation of action potential. If the delivered current is larger, the maximal motor response is reached. The variables of current are duration and intensity. The intensity of current depends upon impedance of tissues in between and distance between stimulating surface (needle or catheter) and nerve.

Position and identification are similar to blind landmark based technique. A 21gauge, 35 or 40 mm needle is inserted through interscalene groove behind the subclavian artery. After entering the fascicular sheath by fascial pop, the stimulating current is set as 1mA, 2MHz and 0.1ms. If the muscle response is achieved, reduce the current intensity to 0.35mA. If the muscle response is persistent, local anaesthetic solution can be given.

Some muscle response indicates incorrect needle location. It includes diaphragmatic contraction (phrenic nerve – too anterior position) and contraction of posterior compartment of shoulder (suprascapular nerve – too posterior position)

ULTRASOUND GUIDED SUPRACLAVICULAR BLOCK[8]

The key requirement for regional anaesthesia is local distribution of local anaesthetic around nerve structure. The goal is most effectively achieved under sonographic visualization. Ultrasound shows ‘real time’ imaging so that nerve structure and position, needle entry and local anaesthetic solution distribution can be best visualised under sonographic guidance.

TECHNIQUES

1) ***Position:*** Patient is placed in supine position and head turned by 45 degrees opposite to the side to be blocked. The anaesthesiologist stands behind the patient on the side the arm is to blocked. The arm kept along the body with elbow flexed, hand extended and placed over the abdomen. The neck should be extended by keeping a towel under the scapula if possible or elevating the patient head end by 45 degrees (semisitting position). The ultrasound transducer, screen, needle and plane of imaging should be placed before the operator on same side.

2) ***Ultrasound Settings***: The 38mm linear array probe is set at high frequency (5 – 12 MHz) to identify the relevant structures. The transducer should be held between index and thumb finger while little finger and ulnar aspect of hand rest on the neck. Scanning mode, gain and depth of field are optimized.

3) ***Sonoanatomy:*** Ultrasound gel is applied over transducer. Transducer is placed on supraclavicular fossa after identifying hyperechoic clavicle bone. Then identify hyperechoic first rib and hyperechoic pleura beneath it. Then identify the pulsatile hypoechoic subclavian artery superficial to first rib. Brachial plexus is found superficial and lateral to subclavian artery as multiple hypoechoic structures (honey comb appearance) and then colour Doppler is applied to know the vessels if present in between the nerves before needle is inserted. Brachial plexus and subclavian artery lie between two scalene muscles. Transducer shall move from lateral to medial (coronal oblique to transverse view) for tracing the brachial plexus and confirmation. Brachial plexus is found as hypoechoic linear structure in interscalene groove.

4) ***Technique :***

After checking the emergency equipment and securing the intravenous line, intravenous fluids, ECG, pulseoxymeter, blood pressure monitor is connected.

Asepsis is achieved by draping the blockade site with betadine and sterile sheath is covered around blockade site.

After identify the brachial plexus, skin and subcutaneous wheal is raised at lateral aspect of the transducer with 2% lignocaine. Needle is inserted over skin wheal. Needle goes parallel to the ultrasonic beam with short angle as inplane approach. Needle bevel should face upwards towards the ultrasonic transducer. It improves the visibility of needle tip. A 21gauge, 50mm needle is inserted parallel to ultrasonic beam. The needle tip is advanced

slowly under real time imaging towards brachial plexus neural structures. If needle tip goes out of plane imaging, manipulate the transducer or redirect the needle. But manipulating the transducer is always preferred over redirection of needle because of patient discomfort.

Once the needle tip is close to the brachial plexus structures under real time viewing, test injection of 2ml of 0.5% bupivacaine is injected to assess the spread around structures after aspiration for blood. If local anaesthetic is not seen on the screen, stop the injecting solution and readjust the needle to complete encirclement of full volume of local anaesthetic around brachial plexus. Local anaesthetic solution appear as hypoechoic structure.

If nerve stimulator is available, it improves confirmation of neural structure. The combination of ultrasound and nerve stimulator confirmation improves the success rate of supraclavicular block.

COMPLICATIONS

1) Neuropathy – it is devastating complication

Etiology : mechanical injury (needle trauma), nerve edema, haematoma, pressure effect of local anaesthesia injectate and neurotoxicity of injecting solution . confounding factors are pre-existing neuropathies (diabetic neuropathy), surgical manipulation, compression from post operative casting and prolonged tourniquet pressure.

Classification – 1: Neuropraxia – mild insult in which both the axon and the connective tissue supporting it remain intact.

Axonotmesis – axonal interruption with preservation of connective tissue. Regeneration occurs at rate 2mm/day. Recovery is favourable but not complete.

Neuronotmesis – complete fascicular interruption including axon and connective tissue. Recovery is poor even after surgical reapproximation of two stumps.

Prevention - pain on injection, injection pressure monitoring (injection pressure >20psi is specific sign of infrafascicular needle tip placement).

MANAGEMENT

- ❖ Good communication is essential both for patient comfort and medicolegal problems
- ❖ Most of the sensory changes will resolve within 4-6 weeks.
- ❖ Evaluate the surgical cause.
- ❖ If motor deficit is present or complete , severe neuropathy is present should be seen immediately by neurophyscician or neurosurgeon.

2) Pneumothorax, phrenic nerve palsy, horner syndrome and artery or any structural injury have lower incidence than blind method.

REVIEW OF LITERATURE

Regional anaesthesia is a well accepted modality of anaesthesia to achieve clinical and economic benefits to patients in the perioperative period. It includes intraoperative surgical anaesthesia, postoperative analgesia, early ambulation after surgery and less incidence of thromboembolic and cardiac events. But there is aninherent failure rate even in best hands in regional anaesthesia. The reason behind that is variation in human anatomy exist and structures deep inside are identified by human anatomical landmarks.

Peripheral nerve block performed with blind techniques has failure rate of 20%.Our main aim is distribution of local anaesthetic solution around nerves and that drugs block the nerve effectively. Ultrasonography satisfies the first aim by provide a real time imaging of nerve structures and local anaesthetic distribution. So that minimum volume of drugs are enough to block the nerves effectively.

1) ***Winnie and Ramamoorthy (1977)*** postulated that drugs block the nerves from peripheral (mantle) to central (core) fibres. Thus order of blockade is as follows: loss of motor power of

arm, loss of sensation of arm, loss of motor power to the forearm and loss of sensation to the hand.

2) ***Lanz et al (1983)*** experimented the extent of blockade using various techniques of brachial plexus block. They concluded that subclavianperivascular approach of Winnie resulted in homogenous blockade of brachial plexus.

3) ***Stephan Kapral et al (1994)*** investigated 40 patients with the use of ultrasound guidance for supraclavicular brachial plexus block. They concluded that ultrasound guided approach combines the safety of axillary block with larger extent of block of the supraclavicular block.

4) ***Perlas A et al (2009)*** conducted a study on 510 patients who received ultrasound guided supraclavicular block. They concluded that ultrasound guided supraclavicular block is associated with high success rate and a low rate of complications.

5) ***Cox et al (1998)*** conducted a clinical study to compare S(-) bupivacaine with racemic bupivacaine in supraclavicular block by nerve stimulator technique. They concluded that there is no significant difference between groups in onset and

duration of sensory and motor blockade and demonstrated that S(-) bupivacaine has reduced toxic potential compared with bupivacaine.

6) ***ShaliniSardesai et al (2014)*** conducted a clinical study between bupivacaine and levobupivacaine by ultrasound guided supraclavicular block. They concluded that levobupivacaine was safer, had rapid onset and longer action than bupivacaine and block quality was similar to bupivacaine.

7) ***Jose Riccardi et al (2009)*** conducted comparative clinical study between bupivacaine and levobupivacaine by nerve stimulator techniques. They demonstrated that anaesthetic quality of levobupivacaine is similar to that of racemic bupivacaine.

8) ***Smyrna et al*** conducted comparative study of levobupivacaine and bupivacaine in axillary brachial plexus block and concluded levobupivacaine has rapid sensory and motor onset time without significant difference in block duration.

9) ***Dr.Chaur J Pandya*** compared analgesic and anaesthetic property of levobupivacaine with bupivacaine. They concluded levobupivacaine has similar clinical profile as bupivacaine however safety profile of levobupivacaine confers an advantage over racemic bupivacaine.

10) ***Cacciapuoti et al (2002)*** evaluated the clinical profile of levobupivacaine, bupivacaine and ropivacaine in brachial plexus block. They concluded levobupivacaine is as effective as racemic bupivacaine with longer duration of sensory block and quicker surgical onset and in comparison with ropivacaine, levobupivacaine showed similar onset but longer duration of sensory and motor block.

11) ***CenkIlham et al (2014)*** conducted efficiency study of levobupivacaine and bupivacaine by nerve stimulator technique. They concluded that bupivacaine lead to faster sensory and motor onset compared to levobupivacaine however had similar duration of postoperative analgesia.

MATERIALS AND METHODS

After obtaining ethics committee approval, this study was carried out in the orthopaedic surgery theatre, Rajivgandhi Government General Hospital, Chennai. The aim of the study was to compare ultrasound guided supraclavicular block using bupivacaine or levobupivacaine in patients undergoing elective upperlimb surgeries.

STUDY DESIGN

A prospective, randomised study conducted on 60 ASA PS I & II presenting for elective upper limb surgeries under supraclavicular block who fulfil the inclusion criteria.

After getting the written informed consent from all patients, they were randomly assigned to two groups

TWO GROUPS

Group-A: Preoperative ultrasound guided supraclavicular block with 0.5% bupivacaine (0.4ml/Kg)

Group-B: Preoperative ultrasound guided supraclavicular block with 0.5% levobupivacaine (0.4ml/Kg)

INCLUSION CRITERIA

- Age : 18 years and above
- Weight : BMI < 30 Kg/m2
- ASA : I & II
- Surgery : Elective
- Mallampatti scores : I & II
- Who have given valid informed consent.

EXCLUSION CRITERIA

- Not satisfying inclusion criteria.
- Patients posted for emergency surgery
- Patients with difficult airway
- Lack of written informed consent
- Pregnant female
- H/O seizures and any neurological deficit
- Severe renal , hepatic, respiratory or cardiac disease
- Severe coagulopathy
- Allergy to local anaesthetic drugs

PRIMARY OUTCOME MEASURES

- Systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate changes during intra operative period.
- Onset and duration of sensory and motor blockade

SECONDARY OUTCOME MEASURES

- Post operative opioid requirements

MATERIALS

- Ultrasonic machine 2D & 7.5-11 MHz ultrasonic scanning probe
- 21G , 50mm needle
- Drugs –inj.bupivacaine, inj. Levobupivacaine
- Monitors – ECG,NIBP,SPO2.
- Equipments and drugs for resuscitation
- Equipments and drugs for conversion to general anaesthesia in the case of block failure

METHODS

Pre Operative Preparation

Patients were preoperatively assessed and obtained written informed consent after explaining the procedure to the patient.

Pre Medication

Tab.ranitidine 150mg 2 hours before surgery with sips of water.

CONDUCT OF ANAESTHESIA

On arrival of the patient to the operating theatre, standard monitors like ECG, non invasive blood pressure and pulse oximeter were commenced and baseline values were recorded. A 18G intravenous line was established in the opposite arm and infusion started with Ringer lactate solution or normal saline solution.

PROCEDURE

1) ***Position :*** Patient is placed in supine position and head turned by 45 degrees opposite to the side to be blocked. The anaesthesiologist stands behind the patient on the side the arm is to blocked. The arm kept along the body with elbow flexed, hand extended and placed over the abdomen. The neck should be extended by keeping a towel under the scapula which brings scapula and humerus forward if possible or

elevating the patient head end by 45 degrees (semisitting position) and push the pillow behind the patient head to opposite side and away from working area. These two steps are to create a space in which needle can be manipulated easily. The ultrasound transducer, screen, needle and plane of imaging should be placed before the operator on same side.

2) ***Ultrasound Settings:*** The 38mm linear array probe is set at high frequency (7.5-11 MHz) to identify the relevant structures. The transducer should be held between index and thumb finger while little finger and ulnar aspect of hand rest on the neck. Scanning mode, gain and depth of field are optimized.

3) ***Sonoanatomy :*** Ultrasound gel is applied over transducer. Transducer is placed on supraclavicular fossa after identifying hyperechoic clavicle bone. Then identify hyperechoic first rib and hyperechoic pleura beneath it. Then identify the pulsatile hypoechoic subclavian artery superficial to first rib. Brachial plexus is found superficial and lateral to subclavian artery as multiple hypoechoic structures (honey comb appearance) and then colour Doppler is applied to know the vessels if present in between the nerves. Brachial

plexus and subclavian artery lie between two scalene muscles. Transducer shall move from lateral to medial (coronal oblique to transverse view) for tracing the brachial plexus and confirmation. Brachial plexus is found as hypoechoic linear structure in interscalene groove.

4) ***Technique***

After checking the emergency equipment and securing the intravenous line, intravenous fluids, ECG, pulseoxymeter, blood pressure monitor is connected.

Asepsis is achieved by draping the blockade site with betadine and sterile sheath is covered around blockade site. Sterile ultrasonic gel is applied over transducer and then transducer is placed in sterile cover to prevent air trapping.

Transducer is placed on the supraclavicular fossa just behind the center of the clavicle and orientate the side marker towards the medial side of clavicle. Then drift the lateral part of transducer 1cm away from the clavicle. This will allow some movement to help align the transducer and needle. Then identify the structures by sonoanatomy.

After identifying the brachial plexus, skin and subcutaneous wheal is raised at lateral aspect of the transducer with 2% lignocaine. Needle is inserted over skin wheal. Needle should go parallel to the ultrasonic beam with steep angle as ‘in plane’ approach. Needle bevel should face upwards parallel to the ultrasonic beam. It improves the visibility of needle tip. A 21gauge, 50mm needle is inserted parallel to ultrasonic beam. The needle tip is advanced slowly under real time imaging towards brachial plexus neural structures. If needle tip goes out of plane imaging, manipulate the transducer or redirect the needle. But manipulating the transducer is always preferred over redirection of needle because of patient discomfort.

Once the needle tip is close to the brachial plexus structures under real time viewing, test injection of 2ml of 0.5% bupivacaine or levobupivacaine is injected to assess the spread around structures after aspiration for blood. If local anaesthetic is not seen on the screen, stop the injecting solution and readjust the needle to confirm the position.

Group A patients receive bupivacaine solution (0.4ml/Kg) where as Group B patients receive levobupivacaine solution (0.4ml/Kg).

EVALUATION OF THE BLOCK

The following observation were made

- Vital signs monitoring: heart rate, non invasive blood pressure and oxygen saturation were measured every 5 minutes until the end of surgery. For statistical purpose, we were documented at 0, 5, 10, 15, 30minutes and every 30 minutes thereafter.

- After administering the drug, patients were evaluated for the onset of sensory and motor blockade every minute.

- Onset of sensory block evaluated by using surgical spirit soaked cotton in the dermatome C4-T2.

- Onset of motor block evaluated by shoulder flexion and extension, forearm flexion and extension, thumb and second digit pinch and thumb and fifth digit pinch. Only patient with complete motor block are included in the study. Failure of the block to be concluded after 20 minutes.

- Onset of sensory block time was the time to first loss of temperature sensation in any dermatome with time 0 min being the time completion of injection.

- Onset of motor block time was the time to first loss of motor power of any muscular compartment

- Duration of sensory block was the time from onset to complete recovery of sensation

- Duration of motor block was the time from onset to complete recovery of motor power

- Assessment of sensory and motor block were carried out every 30 minutes in postoperative period

- Quality of block was assessed by three point scale

  Grade 0 – complete failure

  Grade 1 – unsatisfactory block

  [Inadequate analgesia

  Inadequate relaxation

  Require GA because of agitation or restlessness]

  Grade 2 – satisfactory block

- After confirmation that the block was taken up, patient sedated with Inj.Midazolam 1-2mg

- Local anaesthetic toxic reactions and complication associated with the technique were looked for.

All the data were subjected to statistical analysis.

OBSERVATION AND RESULTS

TREATMENT GROUPS

Treatment Groups	Group Names	Treatment	Number of Subjects
Group A	Bupivacaine	Bupivacaine through ultrasound guided supraclavicular block in patients undergoing elective upper limb surgeries	30
Group B	Levobupivacaine	Levobupivacaine through ultrasound guided supraclavicular block in patients undergoing elective upper limb surgeries	30

STATISTICS

Descriptive statistics was done for all data and suitable statistical tests of comparison were done. Continuous variables were analysed with the student's t-test and categorical variables were analysed with the Chi-Square Test and Fisher Exact Test. Statistical significance was taken as $P < 0.05$. The data was analysed using EpiInfo software (7.1.0.6 version; Center for disease control, USA) and Microsoft Excel 2010.

SAMPLE SIZE CALCULATION

Sample size was determined on the basis of a pilot study in which the increase in onset and duration of analgesia was measured as 15% in Levobupivacaine. We calculated a minimum sample size of 24 patients was required in each group, assuming a type 1 error (two-tailed) of 0.05 and a margin of error of 10%. Therefore, the final sample selected was n=30 in Group A and n=30 in Group B.

$$n = \frac{t^2 \times p(1-p)}{m^2}$$

Description

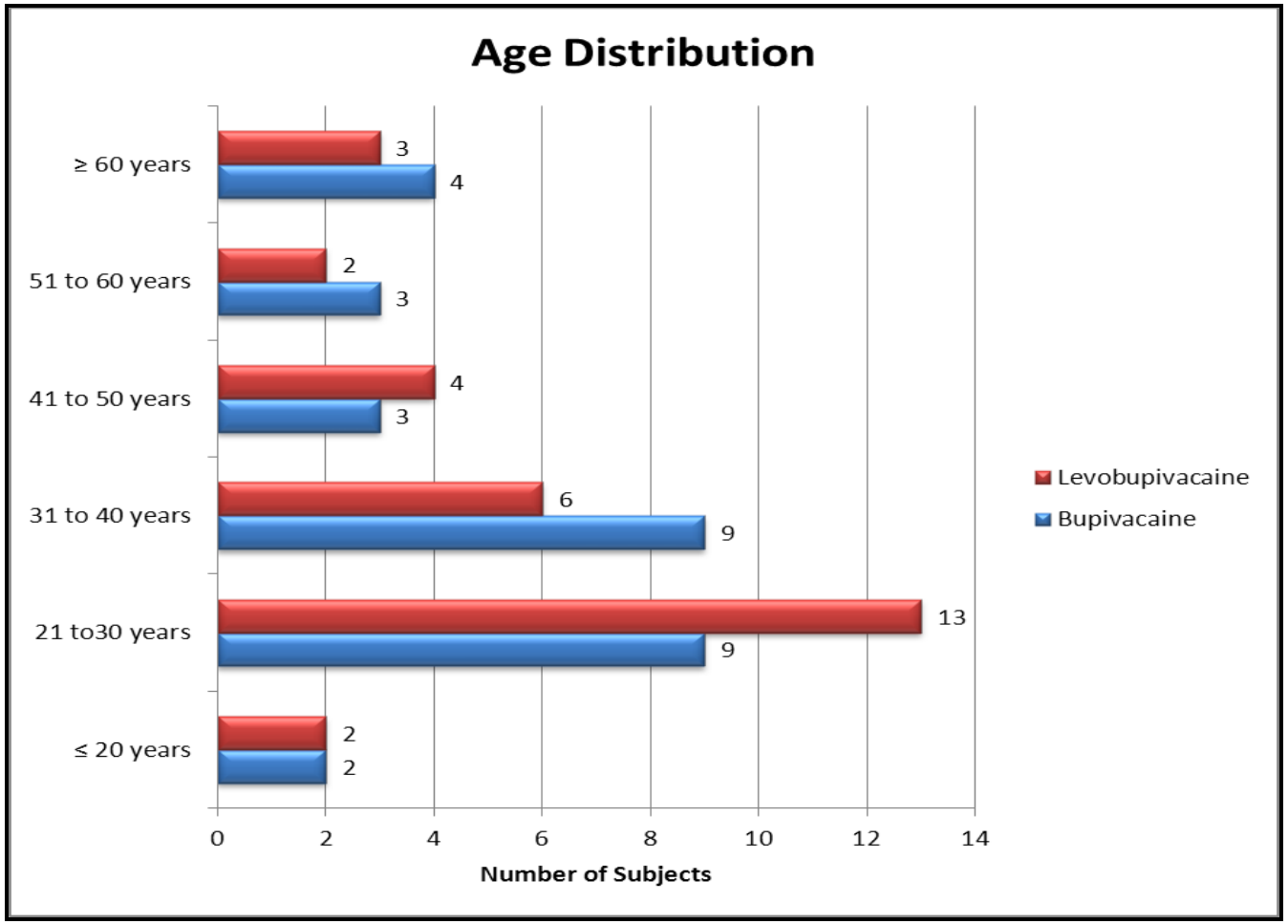
n = required sample size. t = confidence level at 95% (standard value of 1.96). p = estimated prevalence of malnutrition in the project area. m = margin of error at 10% (standard value of 0.05)

$$n = \frac{(1.96)^2 \times 0.15(1-0.15)}{(0.1)^2}$$

$$n = \frac{3.8146 \times 0.1275}{0.01}$$

= 24 per group

AGE

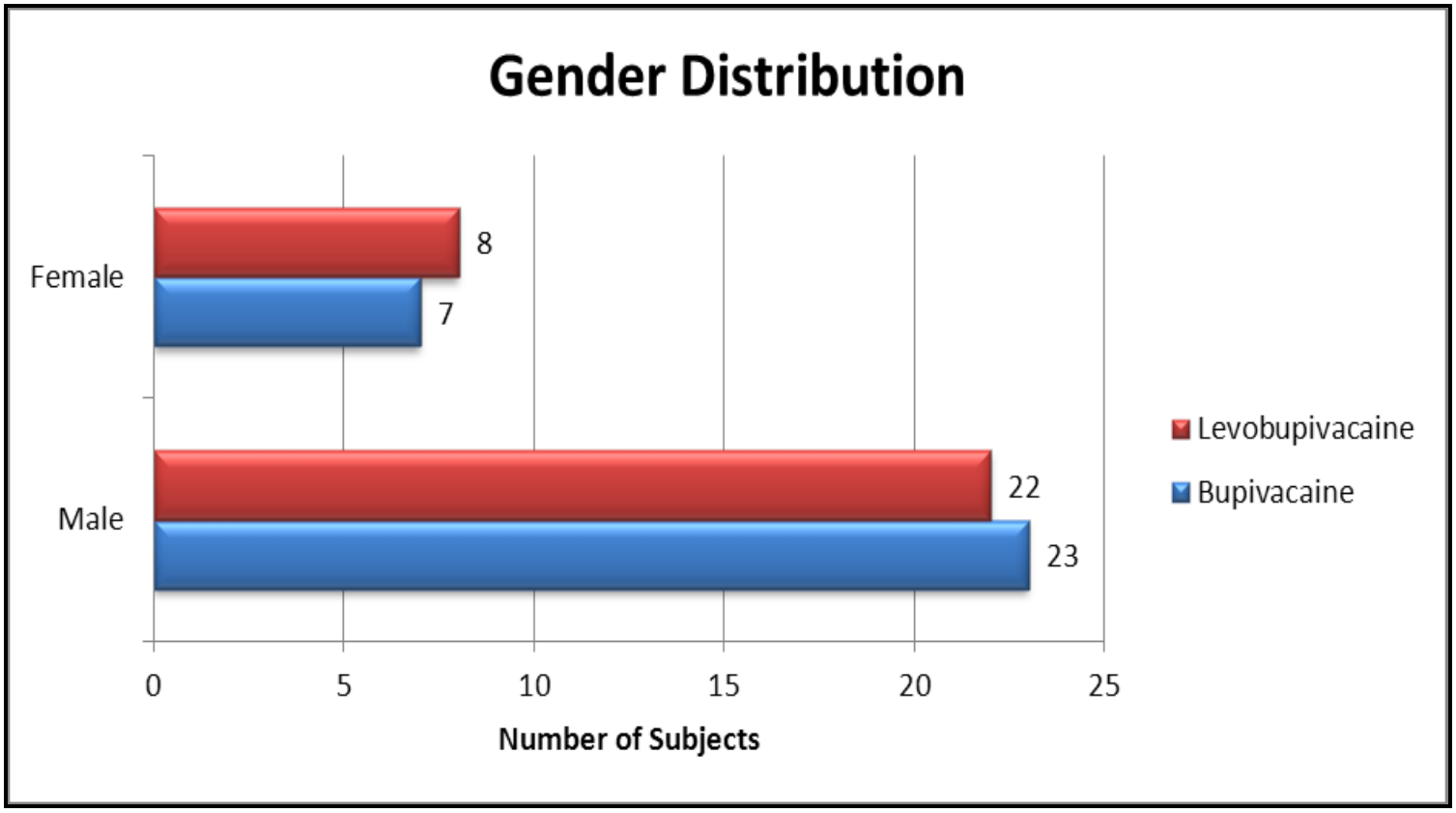

Age Distribution
≥ 60 years
51 to 60 years
41 to 50 years
31 to 40 years
21 to30 years
≤ 20 years
3
4
2
3
4
3
6
9
13
9
2
2
0
2
4
6
8
10
12
14
Number of Subjects
Levobupivacaine
Bupivacaine

Age Distribution	Bupivacaine	%	Levobupivacaine	%
≤ 20 years	2	6.67	2	6.67
21 to30 years	9	30.00	13	43.33
31 to 40 years	9	30.00	6	20.00
41 to 50 years	3	10.00	4	13.33
51 to 60 years	3	10.00	2	6.67
≥ 60 years	4	13.33	3	10.00
Total	30	100	30	100

Age Distribution	Bupivacaine	Levobupivacaine
N	30	30
Mean	38.86667	35.36667
SD	15.2513	14.70745
P value Unpaired t-test	0.369324091	

By conventional criteria the association between the treatment groups and age is considered to be not statistically significant since $p > 0.05$.

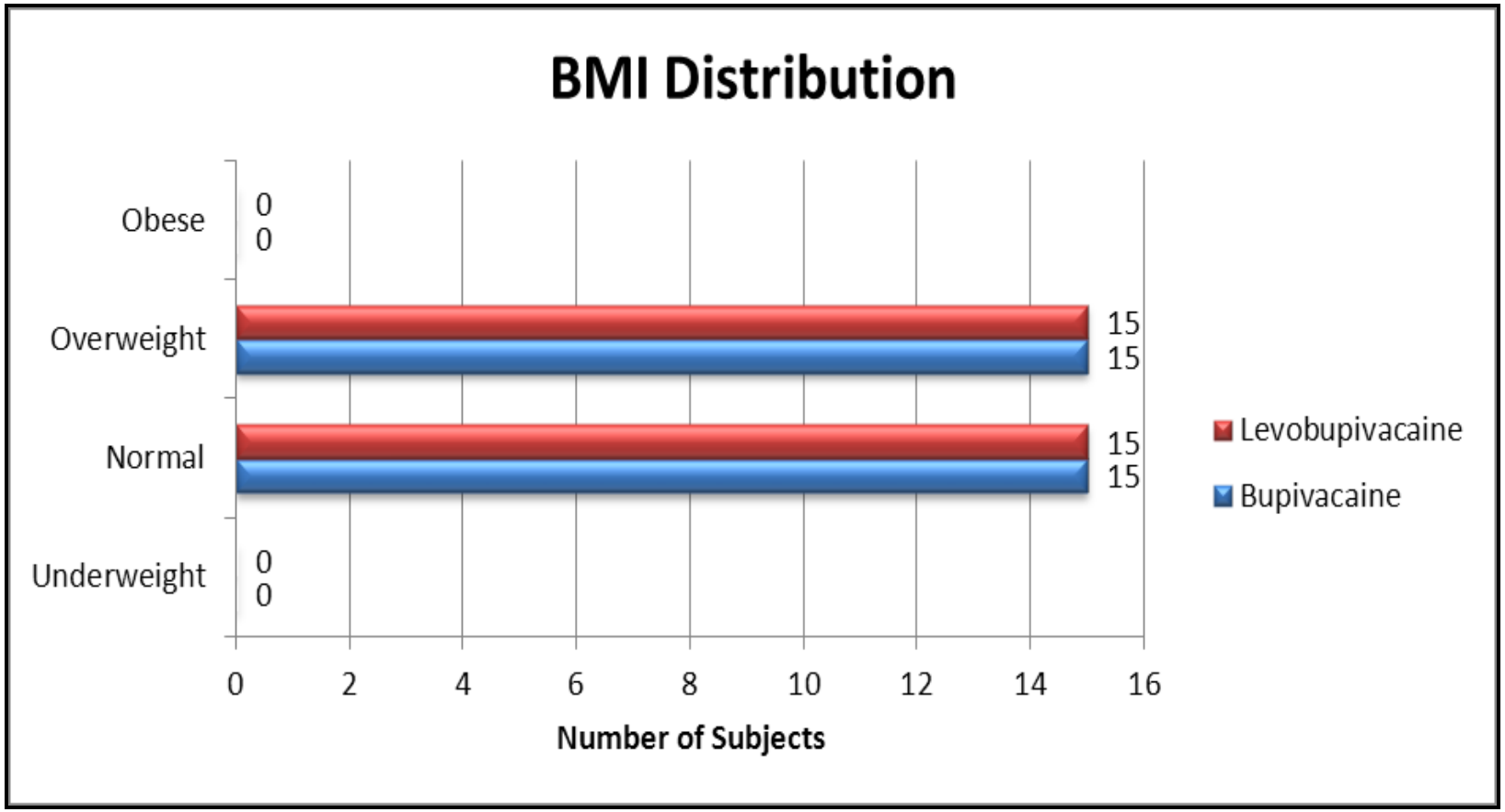
GENDER


Gender Distribution
Female
Male
8
7
22
23
0
5
10
15
20
25
Number of Subjects
Levobupivacaine
Bupivacaine

Gender Distribution	Bupivacaine	%	Levobupivacaine	%
Male	23	76.67	22	73.33
Female	7	23.33	8	26.67
Total	30	100	30	100
Chi-square		0.889		
Degrees of freedom		1		
P value Chi squared Test		0.766		

By conventional criteria the association between the treatment groups and gender is considered to be not statistically significant since $p > 0.05$.

BMI

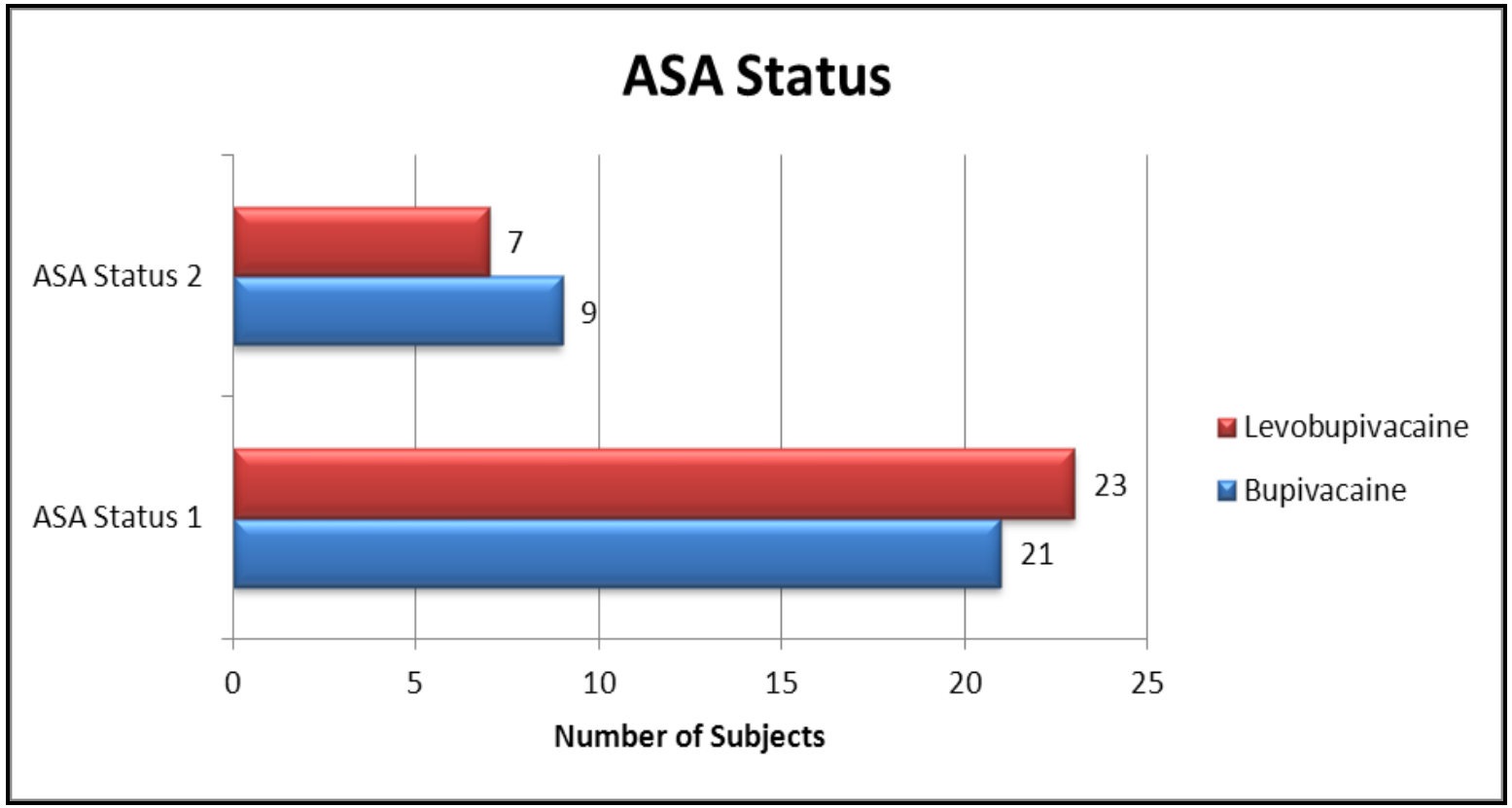

BMI Distribution
Obese
Overweight
Normal
Underweight
0
0
15
15
15
15
0
0
0
2
4
6
8
10
12
14
16
Number of Subjects
Levobupivacaine
Bupivacaine

BMI Distribution	Bupivacaine	%	Levobupivacaine	%
Underweight	0	0.00	0	0.00
Normal	15	50.00	15	50.00
Overweight	15	50.00	15	50.00
Obese	0	0.00	0	0.00
Total	30	100	30	100

BMI Distribution	Bupivacaine	Levobupivacaine
N	30	30
Mean	24.36667	23.56667
SD	2.988291	2.473073
P value Unpaired t-test	0.263439717	

By conventional criteria the association between the treatment groups and BMI is considered to be not statistically significant since $p > 0.05$.

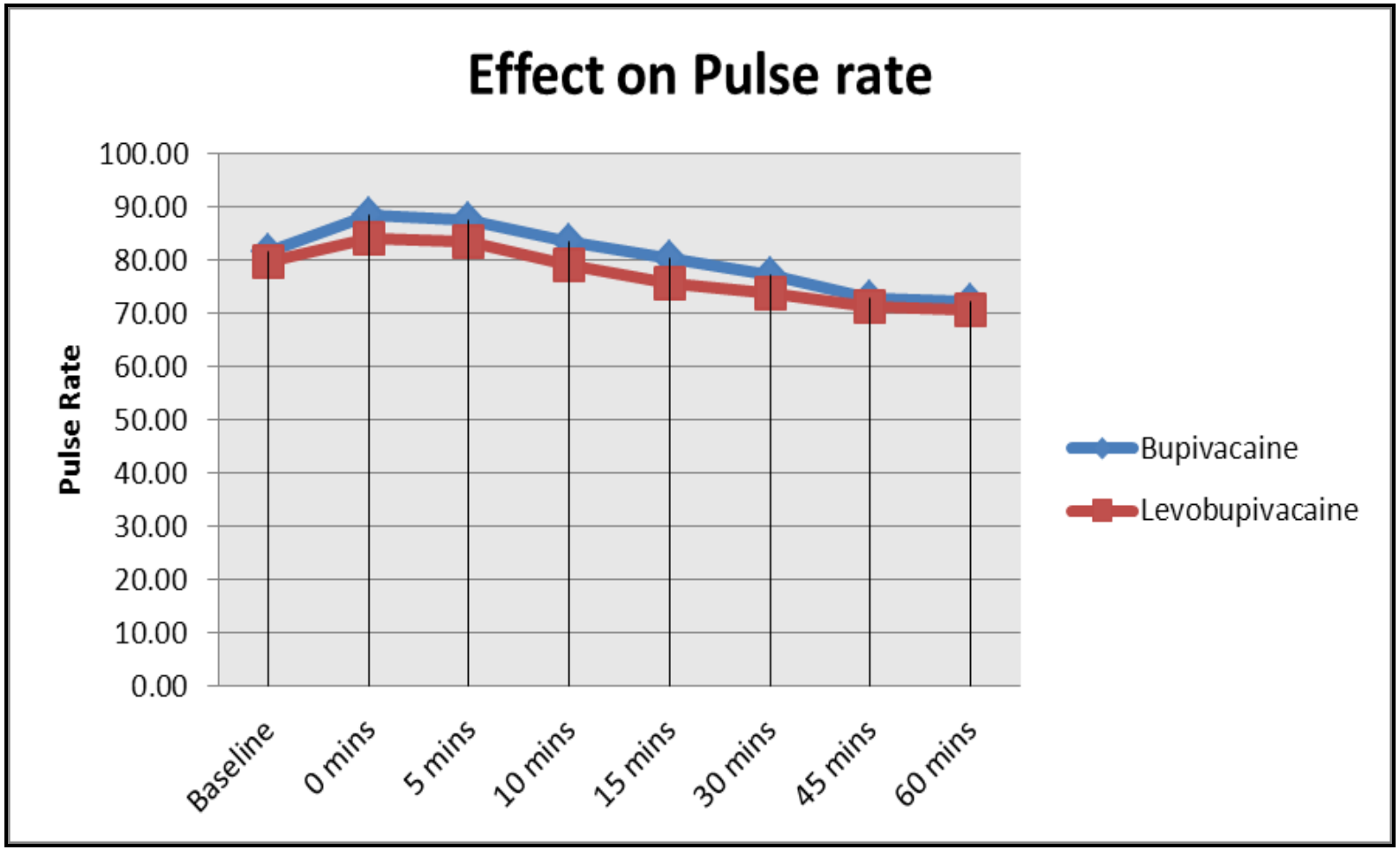
ASA PHYSICAL STATUS CLASSIFICATION SYSTEM



ASA	Bupivacaine	%	Levobupivacaine	%
ASA Status 1	21	70.00	23	76.67
ASA Status 2	9	30.00	7	23.33
Total	30	100	30	100
Chi-square		0.341		
Degrees of freedom		1		
P value Chi squared Test		0.559		

By conventional criteria the association between the treatments groups and ASA status groups is considered to be not statistically significant since $p > 0.05$.

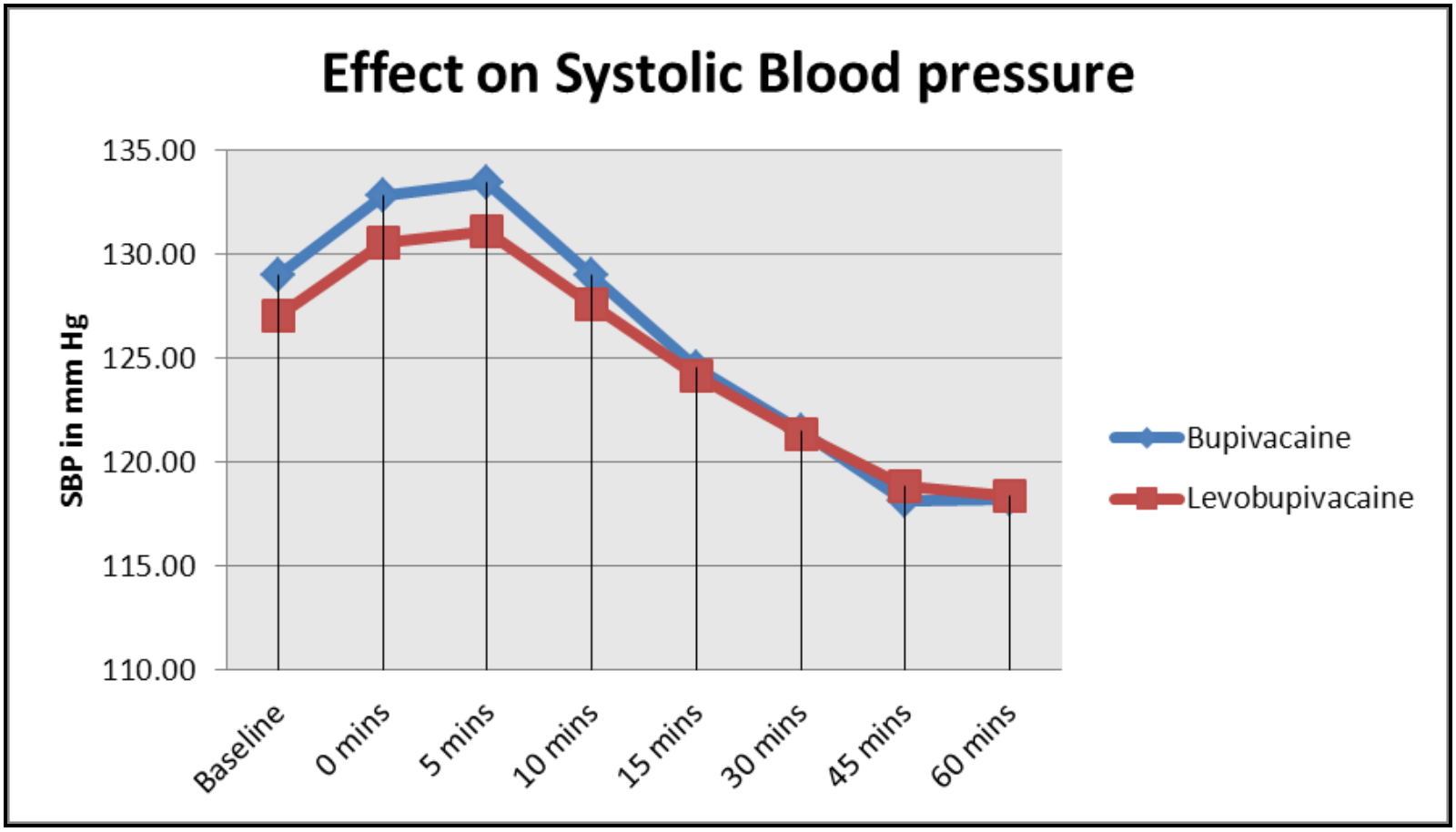
PULSE RATE


Effect on Pulse rate
Pulse Rate
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Baseline
0 mins
5 mins
10 mins
15 mins
30 mins
45 mins
60 mins
Bupivacaine
Levobupivacaine

Pulse Rate		**Baseline**	**0 mins**	**5 mins**	**10 mins**	**15 mins**	**30 mins**	**45 mins**	**60 mins**
Bupivacaine	Mean	81.63	88.43	87.50	83.37	80.27	77.30	72.93	72.30
	SD	9.05	13.03	13.15	12.54	12.54	12.62	10.84	10.01
Levo-bupivacaine	Mean	79.73	84.00	83.43	79.00	75.77	73.93	71.27	70.67
	SD	5.93	6.69	7.60	7.66	8.12	9.09	8.76	8.06
P value Unpaired t-test		0.340755	0.104579	0.149276	0.11018	0.105257	0.240995	0.5152	0.48914

By conventional criteria the association between the treatment groups and effect on pulse rate is considered to be not statistically significant since $p > 0.05$.

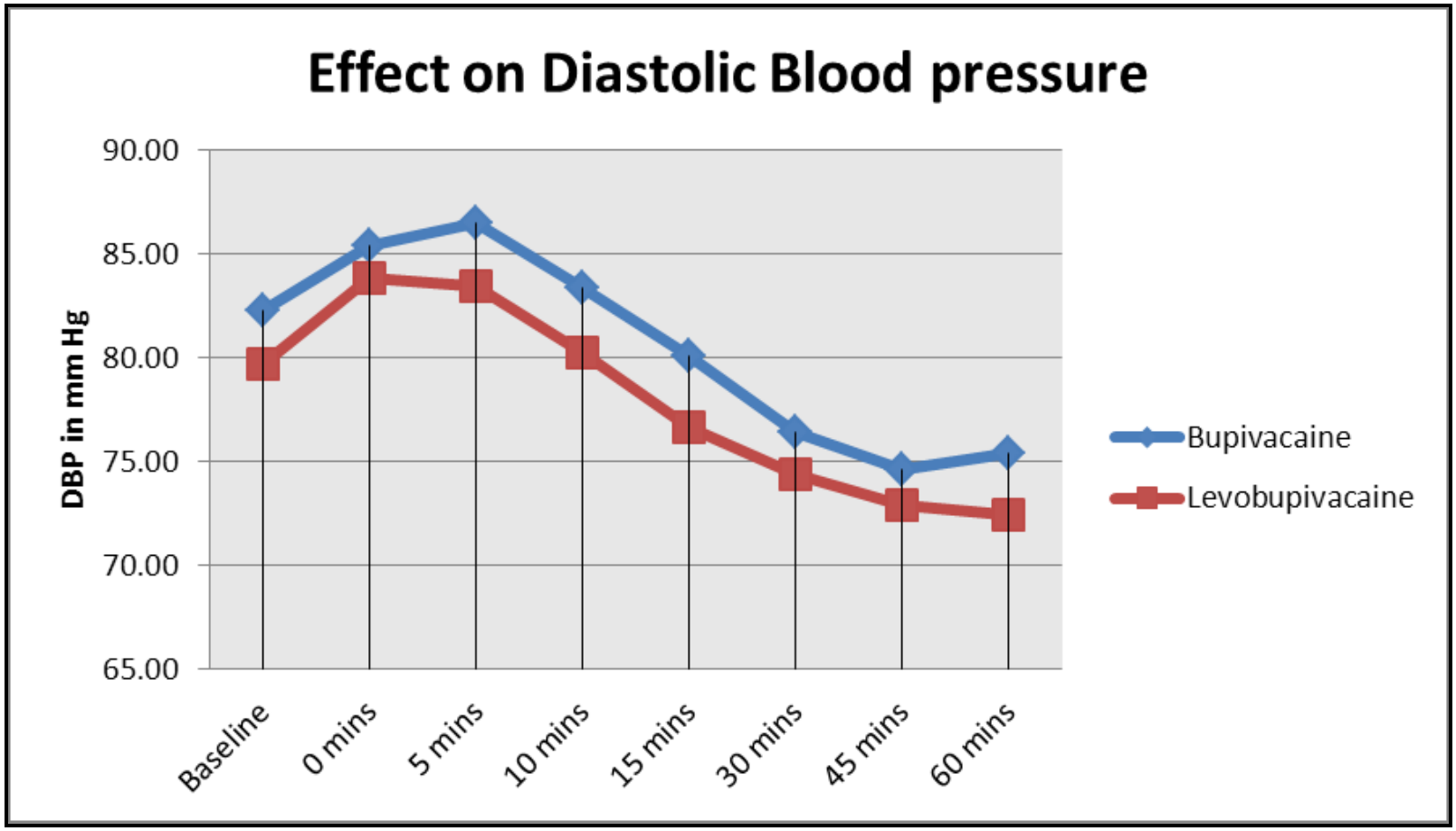
SYSTOLIC BLOOD PRESSURE



Systolic BP		Baseline	0 mins	5 mins	10 mins	15 mins	30 mins	45 mins	60 mins
Bupivacaine	Mean	129.00	132.83	133.47	128.97	124.57	121.50	118.10	118.20
	SD	8.45	10.20	9.32	9.48	9.68	8.32	9.15	8.83
Levo-bupivacaine	Mean	127.03	130.53	131.07	127.60	124.17	121.33	118.83	118.33
	SD	8.34	8.51	9.28	9.44	9.94	9.36	8.57	9.22
P value Unpaired t-test		0.340755	0.36796	0.347029	0.321662	0.577947	0.875089	0.942132	0.749802

By conventional criteria the association between the treatment groups and effect on systolic blood pressure is considered to be not statistically significant since $p > 0.05$.

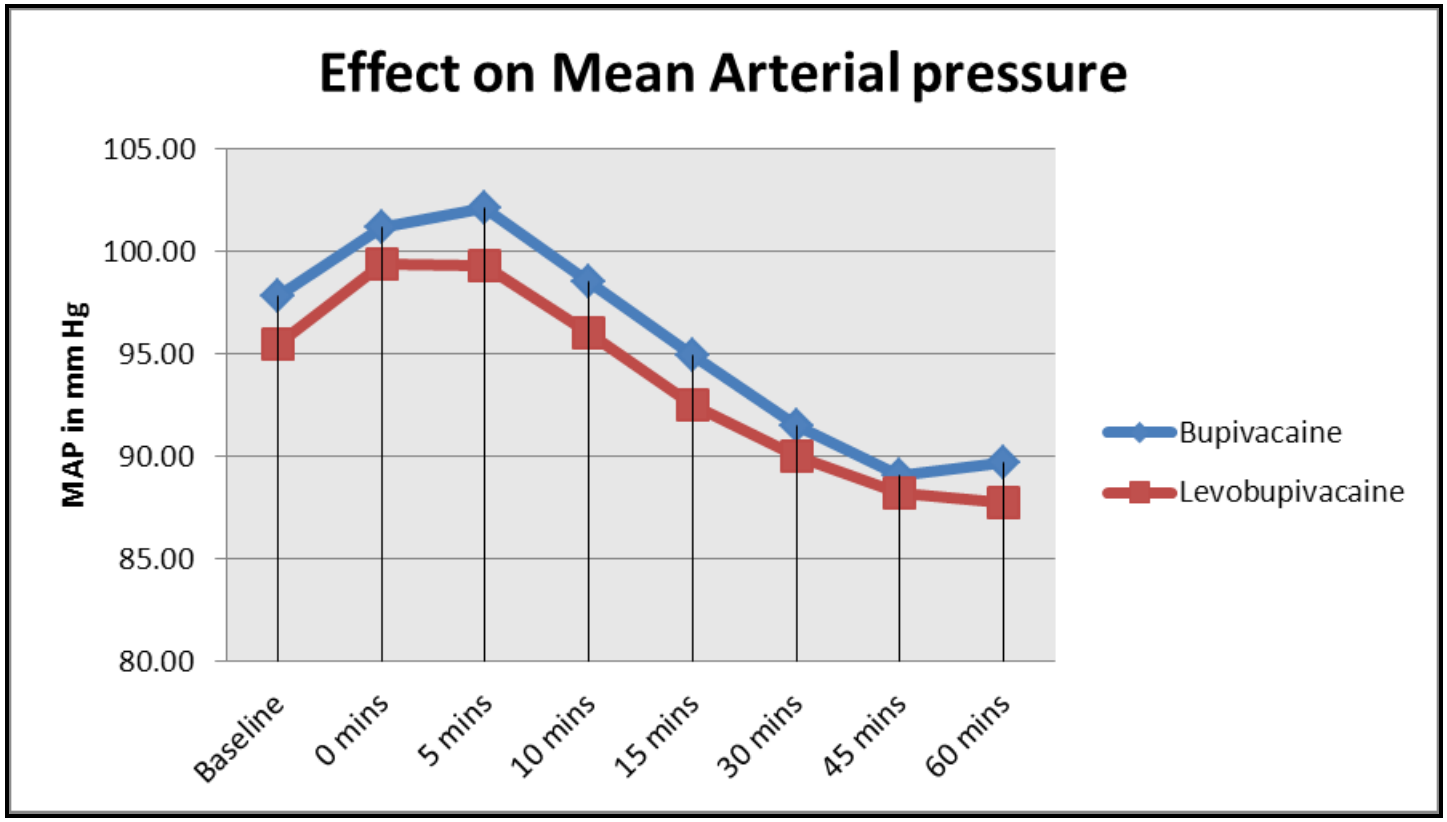
DIASTOLIC BLOOD PRESSURE



Diastolic BP		Baseline	0 mins	5 mins	10 mins	15 mins	30 mins	45 mins	60 mins
Bupivacaine	Mean	82.27	85.40	86.50	83.33	80.07	76.43	74.60	75.43
	SD	7.37	7.13	8.82	10.11	8.81	7.56	6.86	8.34
Levobupivacaine	Mean	79.73	83.80	83.43	80.27	76.67	74.40	72.87	72.40
	SD	6.78	5.85	7.26	7.73	8.07	7.56	6.33	5.92
P value Unpaired t-test		0.340755	0.171175	0.346027	0.146878	0.192411	0.124682	0.302149	0.313162

By conventional criteria the association between the treatment groups and effect on diastolic blood pressure is considered to be not statistically significant since $p > 0.05$.

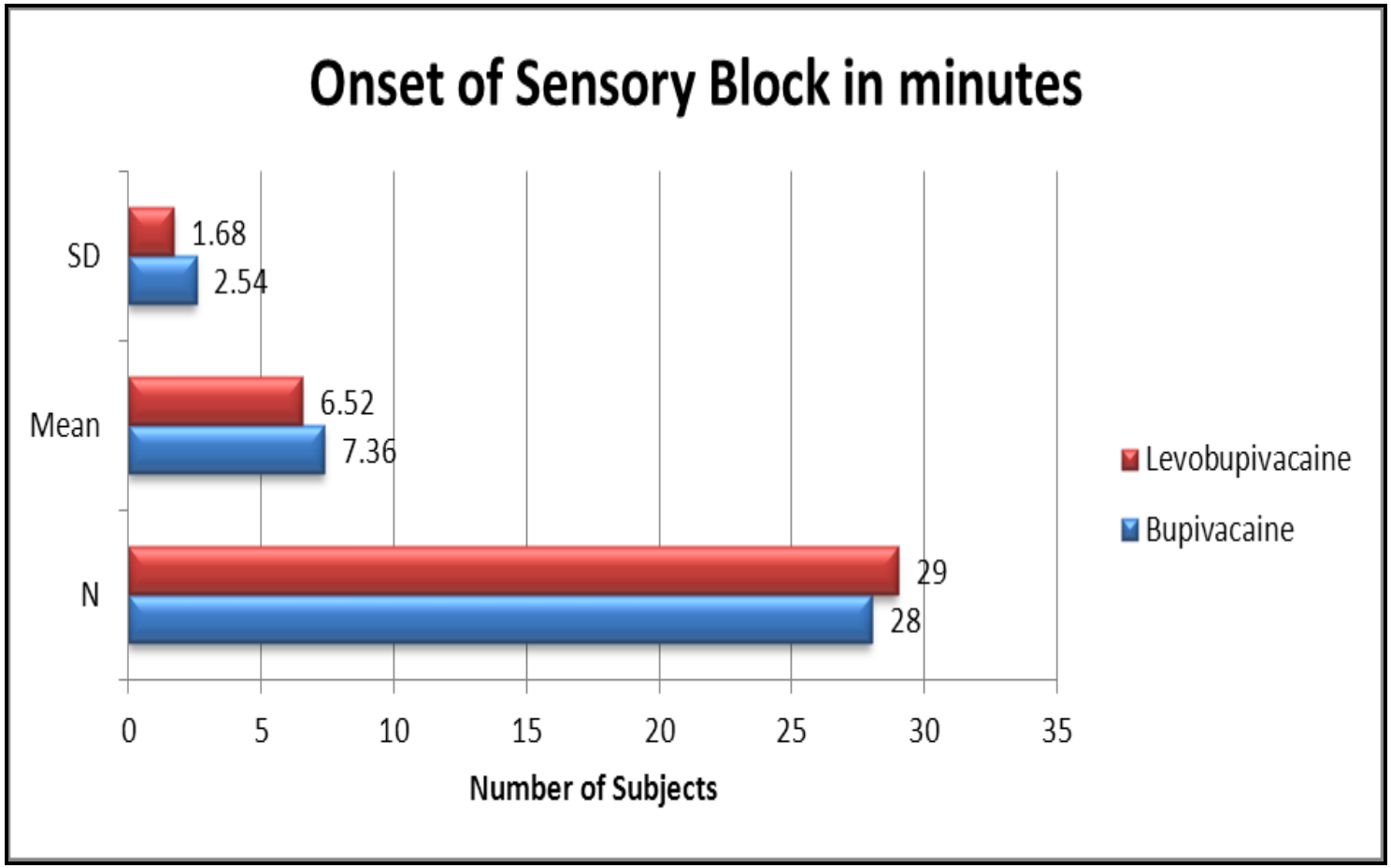
MEAN ARTERIAL PRESSURE



Mean Arterial Pressure		Baseline	0 mins	5 mins	10 mins	15 mins	30 mins	45 mins	60 mins
Bupivacaine	Mean	97.84	101.21	102.16	98.54	94.90	91.46	89.10	89.69
	SD	6.90	7.44	8.48	9.38	8.47	7.37	7.11	7.81
Levobupivacaine	Mean	95.50	99.38	99.31	96.04	92.50	90.04	88.19	87.71
	SD	7.12	6.51	7.53	7.79	8.24	7.84	6.65	6.46
P value Unpaired t-test		0.340755	0.200182	0.314181	0.17464	0.266255	0.270616	0.475379	0.610133

By conventional criteria the association between the treatment groups and effect on mean arterial pressure is considered to be not statistically significant since $p > 0.05$.

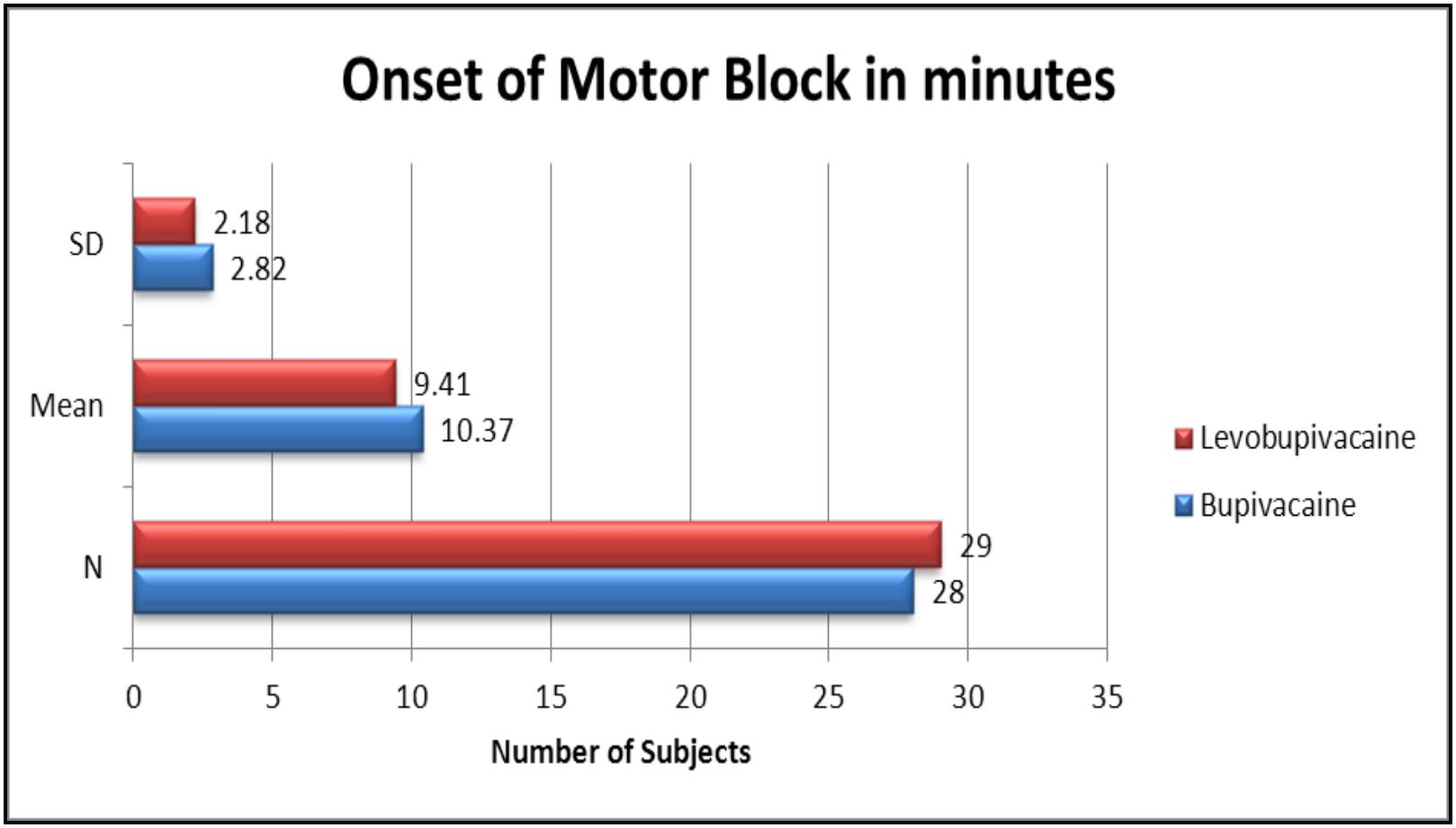
ONSET OF SENSORY BLOCK



Onset of Sensory Block	Bupivacaine	Levobupivacaine
N	28	29
Mean	7.41	6.52
SD	2.58	1.68
P value Unpaired t-test	0.135828665	

By conventional criteria the association between the treatment groups and effect on onset of sensory block is considered to be not statistically significant since $p > 0.05$.

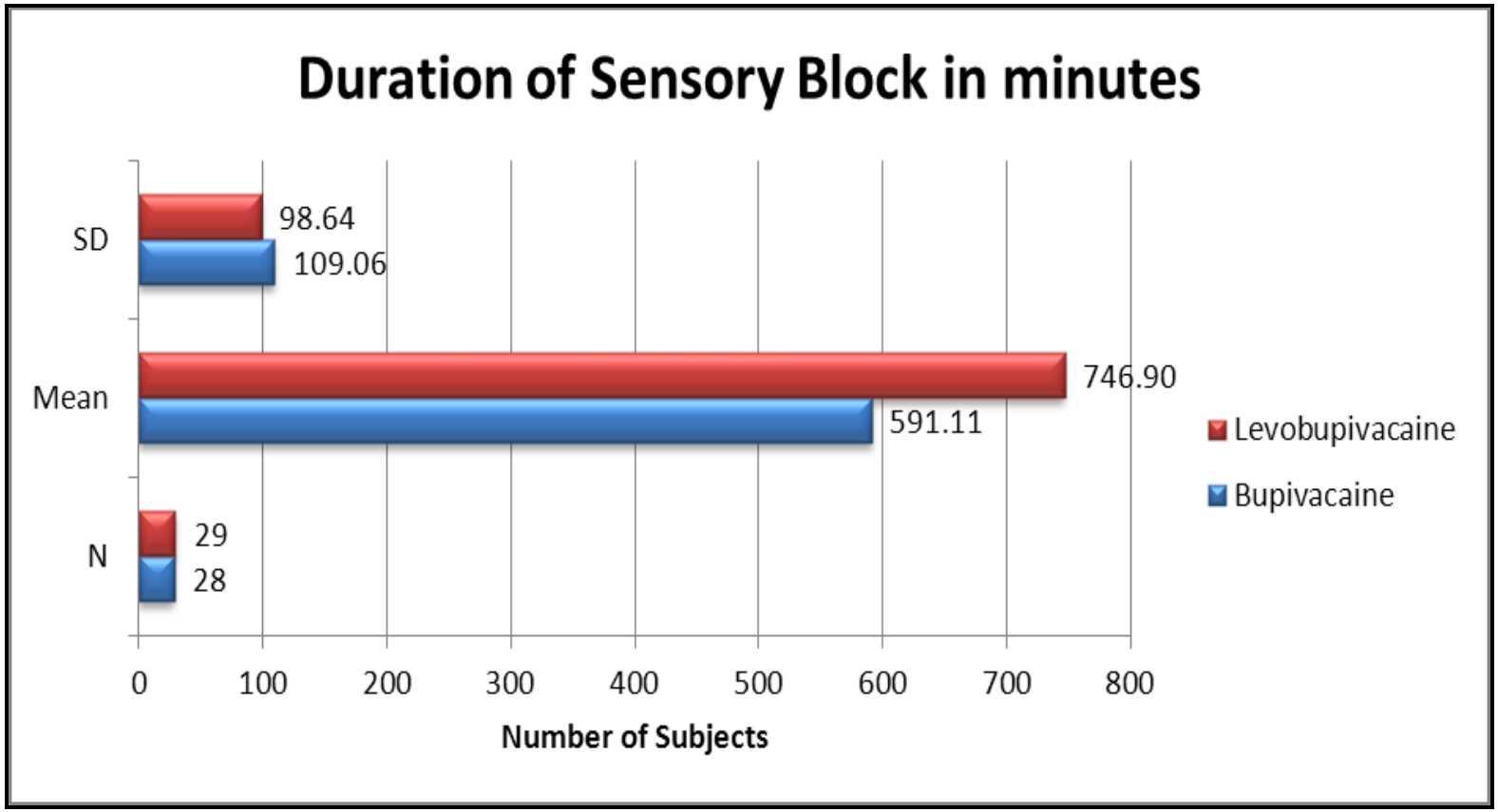
ONSET OF MOTOR BLOCK



Onset of Motor Block	Bupivacaine	Levobupivacaine
N	28	29
Mean	10.37	9.41
SD	2.82	2.18
P value Unpaired t-test	0.163712472	

By conventional criteria the association between the treatment groups and effect on onset of motor block is considered to be not statistically significant since $p > 0.05$.

DURATION OF SENSORY BLOCK



Duration of Sensory Block	Bupivacaine	Levobupivacaine
N	28	29
Mean	591.11	746.90
SD	109.06	98.64
P value Unpaired t-test	0.00823	

By conventional criteria the association between the treatment groups and duration of sensory block is considered to be statistically significant since $p < 0.05$.

STATISTICAL SIGNIFICANCE

This indicates that there is a true difference among treatment groups and the difference is significant. In simple terms, in patients undergoing ultrasound guided supraclavicular block in elective upper limb surgeries, by using levobupivacaine, the duration of sensory block is increased to 746.90 ± 98.64 minutes in comparison with Bupivacaine which takes 591.11 ± 109.06 minutes with a p-value of 0.00823 according to unpaired t-test.

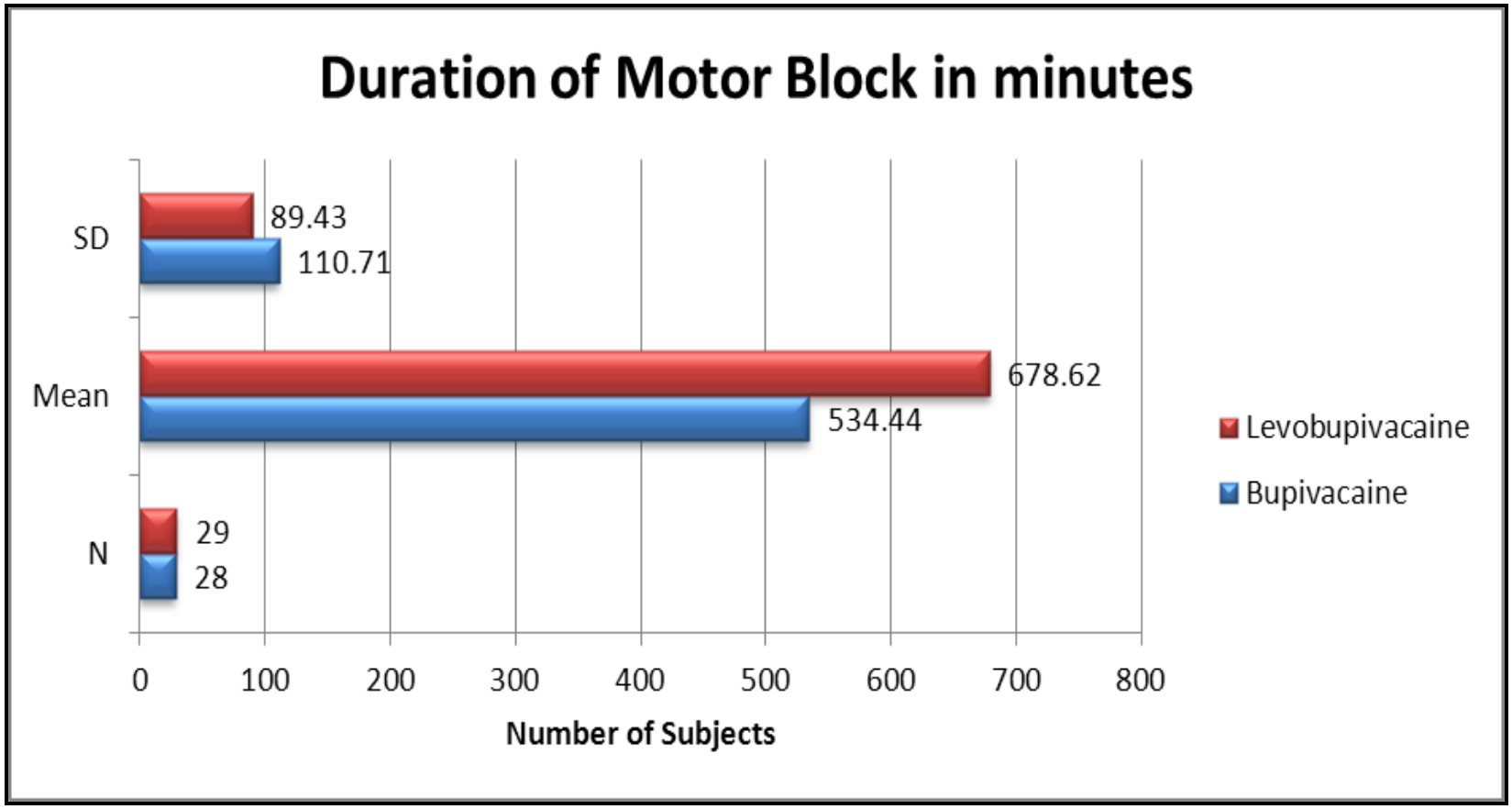
CLINICAL SIGNIFICANCE

The duration of sensory block was meaningfully more (26.35%) in the Levobupivacaine Group compared to the Bupivacaine Group by 155.79 minutes. This difference is true and significant and has not occurred by chance.

CONCLUSION

We conclude that there is real advantage by using Levobupivacaine in patients undergoing ultrasound guided supraclavicular block in elective upper limb surgeries compared to Bupivacaine, which in turn significantly prolongs the duration of sensory block thereby proving advantageous in longer duration surgeries.

DURATION OF MOTOR BLOCK



Duration of Motor Block	Bupivacaine	Levobupivacaine
N	28	29
Mean	534.44	678.62
SD	110.71	89.43
P value Unpaired t-test	0.0229	

By conventional criteria the association between the treatment groups and duration of motor block is considered to be statistically significant since $p < 0.05$.

STATISTICAL SIGNIFICANCE

This indicates that there is a true difference among treatment groups and the difference is significant. In simple terms, in patients undergoing ultrasound guided supraclavicular blockin elective upper limb surgeries, by using levobupivacaine, the duration of motor block is increased to 672 .62± 89.43 minutes in comparison with Bupivacaine which takes 534.44 ± 110.71 minutes with a p-value of 0.0229 according to unpaired t-test.

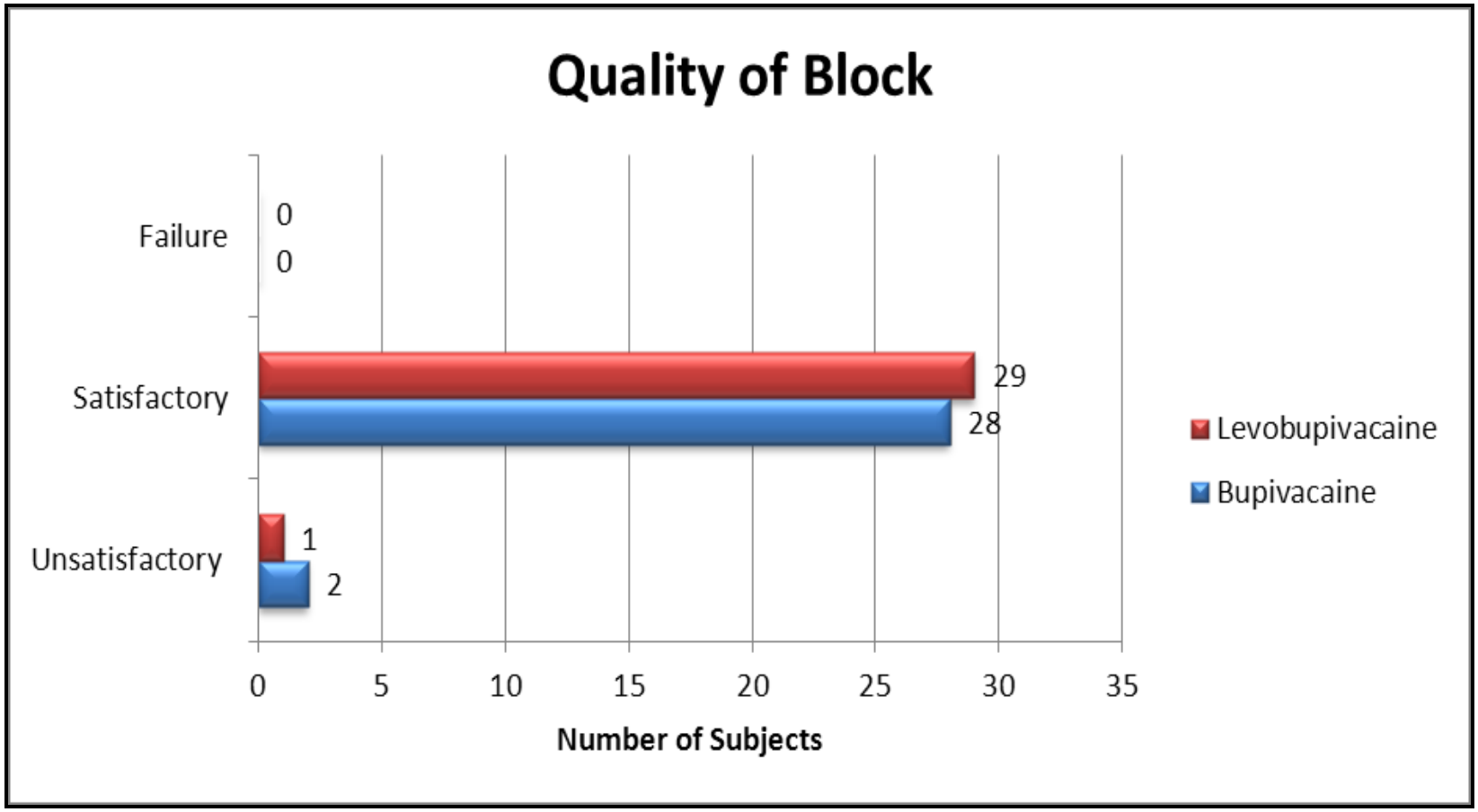
CLINICAL SIGNIFICANCE

The duration of motor block was meaningfully more (26.98%) in the Levobupivacaine Group compared to the Bupivacaine Group by 114.18 minutes. This difference is true and significant and has not occurred by chance.

CONCLUSION

We conclude that there is real advantage by using Levobupivacaine in patients undergoing ultrasound guided supraclavicular block in elective upper limb surgeries compared to Bupivacaine, which in turnsignificantly prolongs the duration of motor block thereby proving advantageous in longer duration surgeries.

QUALITY OF BLOCK



Quality of Block	**Bupivacaine**	**%**	**Levobupivacaine**	**%**
Unsatisfactory	2	6.67	1	3.33
Satisfactory	28	93.33	29	96.67
Failure	0	0.00	0	0.00
Total	30	100	30	100
Chi-square		0.351		
Degrees of freedom		1		
P value Chi squared Test		0.554		

By conventional criteria the association between the treatment groups and effect on quality of block is considered to be not statistically significant since $p > 0.05$.

DISCUSSION

Peripheral nerve block is a well accepted modality to achieve clinical and economic benefits to patients in the perioperative period. The benefits includes intra operative surgical anaesthesia, post operative analgesia and avoid general anaesthetic complications.

Brachial plexus block provides ideal anaesthetic technique for upper limb surgeries. It was first described by Kulenklampf in 1911. The use of this block has tempered by some technical complications. But, interest in supraclavicular block has been rekindled by ultrasonography. It localises the brachial plexus structures, shows the local anaesthetic distribution and minimises the usual technical complications.

Even though we had ideal technique to block the brachial plexus, the ideal local anaesthesia devoid of any toxicity is still on quest. Racemic bupivacaine is widely used local anaesthetic agent for brachial plexus block[9]. However high dosage or any inadvertent intravascular injection may cause fatalities through cardiovascular[10] and central nervous system toxicity[10,13]. These toxic effects

attributed mainly from dextroenantiomer of R(+)bupivacaine[10,11]. So the another enantiomer of levorotatory form of S(+)bupivacaine has less toxic effects. So it emerged as safer alternative with similar clinical profile as racemic bupivacaine.

Levobupivacaine has less tendency to cause cardiac toxicity due to

1) Dextroenantiomer R(+)Bupivacaine has 2.4 times higher affinity for cardiac sodium channels and dissociates it from slowly than levorotatory enantiomer[17].

2) Plasma protein binding of levobupivacaine is >97% where as bupivacaine is 95% which means availability of drug is less in levobupivacaine(<3%) to cause undesired toxic effects[12,13].

3) Levobupivacaine has inherent vasoconstrictor activity which gives prolonged duration of action and less systemic toxicity. Aps Reynolds study demonstrated this postulation[18].

Numerous studies have been done to evaluate the efficiency of levobupivacaine as anaesthetic agent in respect to onset time, duration and analgesic qualities of brachial plexus[14-16].

PRESENT STUDY

The present study was designed to compare bupivacaine and levobupivacaine through ultrasound guided supraclavicular block. In the study 60 patients were randomly assigned into two groups. The two groups were comparable with respect to age, sex and body mass index(BMI). The difference were statistically insignificant (p value >0.05).

ONSET OF SENSORY BLOCK

In the study by Shalini Sardesai et al, the onset of sensory block was faster in levobupivacaine group (6.13+/- 0.34min) than bupivacaine group (7.59+/-1.43). In the study by Cox et al, the onset of sensory block was faster in levobupivacaine group(6min) than bupivacaine(8 min). In the present study the onset of sensory block is faster in levobupivacaine group(6.52+/-1.68) than bupivacaine group(7.41+/-2.58) and p value is 0.1358 so the difference is statistically insignificant.

ONSET OF MOTOR BLOCK

In the study by shalini et al, the onset of motor block was faster in levobupivacaine group (5.05+/-0.29) than bupivacaine group(5.99+/-0.49). In the present study the onset of motor block is faster in levobupivacaine group(9.41+/-2.18) than bupivacaine group(10.37+/-2.82) and p value is 0.1637 so the difference is statistically insignificant.

DURATION OF SENSORY BLOCK

In the study by shalini et al, the onset of motor block was faster in levobupivacaine group (1036.57+/-93.7) than bupivacaine group(871.48+/-174.33). In the present study the onset of sensory block in levobupivacaine group(746.90+/-98.64) is faster than bupivacaine group(591.11+/-109.06) and the difference is statistically significant.

DURATION OF MOTOR BLOCK

In the study by shalini et al, the onset of motor blockwas faster in levobupivacaine group (1049.46+/-95.02) than bupivacaine group(902.37+/-181.46). In the present study the onset of motor block in levobupivacaine group(678.62+/-89.43) is faster than bupivacaine group(534.44+/-110.71) and the difference is statistically significant.

QUALITY OF BLOCK

In the present study blocks with levobupivacaine group were successful in 19 out of 20 cases and in the bupivacaine group were successful in 18 out of 20 cases (2 cases of bupivacaine group and 1 case of levobupivacaine group has considered unsatisfactory block and there was no failure case). The difference is statistically insignificant.

COMPLICATION

There were no complication in both groups during the study.

SUMMARY

On comparing bupivacaine and levobupivacaine in ultrasound guided supraclavicular block it was found that

- The time of onset of sensory and motor blockade was equal in both levobupivacaine and bupivacaine group
- The duration of sensory and motor blockade was prolonged in levobupivacaine group than bupivacaine group
- There were no complications and side effects in both groups
- The haemodynamics were well maintained in both groups

CONCLUSION

From the study it can be inferred that levobupivacaine is longer acting than bupivacaine and its clinical profile is closely resembling to bupivacaine. Safe outcome from anaesthesia is the main goal for anaesthesiologist so the reduced toxic potential of this drug should be considered for regional anaesthesia wherever large volume is required.

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undergoing an axillary brachial plexus block. AANA J 2004;72:339-345.

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INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI-3

EC Reg No.ECR/270/Inst./TN/2013
Telephone No. 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr. J.N.C. HAMILTON,
Postgraduate MD (Anaesthesia),
Madras Medical College,
Chennai – 600 003.

Dear Dr. J.N.C. Hamilton,

The Institutional Ethics Committee has considered your request and approved your study titled **"A Prospective, randomized study comparing bupivacaine and levobupivacaine through ultrasound guided supraclavicular block in patients undergoing elective upper limb surgeries " No. 25082014.**

The following members of Ethics Committee were present in the meeting held on **05.08.2014** conducted at Madras Medical College, Chennai-3.

1. Dr.C.Rajendran, M.D.,	: Chairperson
2. Dr.R.Vimala, M.D., Dean, MMC, Ch-3	: Deputy Chairperson
3. Prof.B.Kalaiselvi, M.D., Vice-Principal, MMC, Ch-3	: Member Secretary
4. Prof.R.Nandhini, M.D., Inst.of Pharmacol ogy, MMC	: Member
5. Dr.G.Muralidharan, Director Incharge, Inst.of Surgery	: Member
6. Prof.K.Ramadevi, Director i/c, Inst.of Biochemistry, MMC	: Member
7. Prof.Saraswathy, M.D., Director, Pathology, MMC, Ch-3	: Member
8. Prof.Tito, M.D., Director i/c, Inst.of Internal Medicine, MMC	: Member
9. Thiru S.Rameshkumar, Administrative Officer	: Lay Person
10. Thiru S.Govindasamy, B.A., B.L.,	: Lawyer
11. Tmt.Arnold Saulina, M.A., MSW.,	: Social Scientist

We approve the proposal to be conducted in its presented form.
The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

INTRODUCTION

Peripheral nerve blocks provide ideal operating condition when used in optimal conditions. They reduce the stress response and least interfere with the vital physiological functions of the body compared to conventional techniques. Adequately administered regional anaesthesia not only provide excellent intraoperative pain relief but also give best post operative analgesia.

When we trace regional anaesthesia origin, Dr. Carl Koller, a young ophthalmologist, employed a cocaine solution for topical corneal anaesthesia in patients undergoing eye surgeries in 1884. Most of the local anaesthetic agents developed in the first half of twentieth century (1900-1940) were basically ester compounds. They lost their importance due to their short

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Character count:	57,052
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INTRODUCTION

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When we trace regional anaesthesia origin, Dr. Carl Koller, a young ophthalmologist, employed a cocaine solution for topical corneal anaesthesia in patients undergoing eye surgeries in 1884. Most of the local anaesthetic agents developed in the first half of twentieth century (1900-1940) were basically ester compounds. They lost their importance due to their short duration of action, systemic toxicity and associated allergic reactions. These paved the way for the synthesis of newer agents namely amide type of local anaesthetic agents.

Brachial plexus block was first performed by William Stewart Halsted in 1889. He directly exposed the brachial plexus in the neck to perform the block using cocaine. Hirschelfirst performed the percutaneous approach of brachial plexus block. Kulenkampf was the first to perform the classical supraclavicular approach to the brachial plexus block. Then Winnie and Collins introduced the subclavian perivascular block. Raj was the first to perform the brachial plexus block through infraclavicular approach. Accardo and Adriano first to introduce the axillary approach.

On subsequent days, regional blocks have been performed using nerve stimulation, anatomical landmarks and of fascia clicks. Blind blocks that rely solely on anatomical landmarks are known to produce serious complications. Even the nerve stimulation technique, recommended as the gold standard for nerve identification in regional blocks over the past decade fails to ensure an adequate level of nerve block. It also carries a risk of damage to nerve structures by direct puncture.

Ultrasound visualisation of anatomical structures offers safe block of superior quality by optimal needle positioning. La Grange and colleagues in 1978 were the first to perform the supraclavicular block through ultrasound blood flow detector. Stephen kapral et al in 1994 published the first reported use

PATIENT CONSENT FORM

STUDY TITLE

"A Prospective, randomized study comparing bupivacaine and levobupivacaine through ultrasound guided supraclavicular block in patients undergoing elective upper limb surgeries"

STUDY CENTER

Institute of Anaesthesiology and Critical Care,
Madras Medical College, Chennai- 600003.

Participant name:
Age:
Sex:
I.P.No:

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the pitfall in the procedure. I have been explained about the safety, advantage and disadvantage of the technique.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving any reason.

I understand that investigator, regulatory authorities and the ethical committee will not need my permission to look at my health records both in respect to current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from the study.

Time :
Date :
Place :

Patient name **Signature / thumb impression of patient**

Signature of the investigator **Name of the investigator**

INFORMATION TO PARTICIPANTS

Investigator :

Name of the participant:

Title:

"A Prospective, randomized study comparing bupivacaine and levobupivacaine through ultrasound guided supraclavicular block in patients undergoing elective upper limb surgeries"

You are invited to take part in this research study. We have got approval from the IEC. You are asked to participate because you satisfy the eligibility criteria. We want to compare ultrasound guided supraclavicular block using bupivacaine or levobupivacaine, in patients undergoing elective upper limb surgeries.

THE PURPOSE OF THE RESEARCH

1) To compare ultrasound guided supraclavicular block using bupivacaine or levobupivacaine, in patients undergoing elective upper limb surgeries with respect to, Intra operative hemodynamics,

2) To compare onset and duration of sensory and motor blockade

STUDY DESIGN

Prospective, randomized, single blinded , case control study 60 patients presenting for elective upper limb surgeries were randomly assigned to two groups.

Group1- pre operative ultrasound guided supraclavicular block with bupivacaine .

Group2- pre operative ultrasound guided supraclavicular block with levobupivacaine.

BENEFITS

Ultrasound guided supraclavicular block pre operatively, reduces intra operative hemodynamics, reduces general anaesthetic complication,causes post operative pain elief.

DISCOMFORTS AND RISKS

Discomfort during block- this will be reduced by local infiltration.

Seizures can occur – since the drug will be given based on calculated maximum allowable dose, this complication does not occur.

Hypotension ,bradycardia may occur – emergency drugs are readily available

Time :

Date :

Place :

Signature / Thumb Impression of Patient
Patient Name:

Signature of the Investigator : _____

Name of the Investigator : _____

PROFORMA

ROLL NO:

DATE:

NAME:
IP NO:

AGE: SEX:

HEIGHT: WEIGHT: BMI:

DIAGNOSIS:

SURGICAL PROCEDURE:

ANAESTHETIC PLAN:

ANY COMORBID ILLNESS:

H/O ANY DRUG ALLERGY:

ASA PS: MMC:

	HR	**SBP**	**DBP**	**MAP**	**SpO2**
Baseline					
SCB					
5 mins					
10 mins					
15 mins					
30 mins					
45 mins					
60 mins					
75 mins					

	HR	SBP	DBP	MAP	SpO2
90 mins					
105 mins					
120 mins					
135 mins					
150 mins					
165 mins					
180 mins					

ONSET OF SENSORY BLOCKADE:

ONSET OF MOTOR BLOCKADE:

DURATION OF SURGERY:

DURATION OF SENSORY BLOCKADE:

DURATION OF MOTOR BLOCKADE:

QUALITY OF BLOCK

SATISFACTORY	UNSATISFACTORY	FAILURE

SIDE EFFECTS/COMPLICATIONS:

S.No	NAME	AGE	SEX	BMI	ASA	BASELINE VITALS				INTRA OP PULSE RATE													
						PR	SBP	DBP	MAP	0 MINS	5	10	15	30	45	60	75	90	105	120	135	150	165
GROUP A																							
1	CHINNASAMY	68	M	25	2	88	134	82	99.33	102	93	88	90	82	74	70	71	75	69	68	72	70	
2	RAMKUMAR	23	M	21	1	102	124	96	105.33	115	104	96	100	84	75	72	79	82	72				
3	RAJAGOPAL	35	M	25	1	84	130	88	102	118	124	96	98	84	78	71	68	78	74	72			
4	ELUMALAI	55	M	28	1	68	138	84	102	74	69	68	71	66	64	59	61	64					
5	SUBRAMANI	60	M	20	2	71	118	74	88.67	71	68	70	69	76	66	64	66	70	72				
6	MUTHUPANDI	35	M	26	1	79	126	84	98	82	80	74	76	72	69	74	78	84	92	98	89	92	96
7	AMUDHA	40	F	24	1	88	138	78	98	92	96	94	84	78	74	80	76	74					
8	AYYAPPAN	18	M	19	1	78	118	74	88.67	78	84	74	72	69	66	64	69						
9	THIRUPATHY	37	M	25	1	84	130	84	99.33	88	92	84	78	72	69	71	74	76	78	84			
10	MOHAMMED	43	M	28	2	78	140	96	110.67	76	80	79	72	68	64	60	70	72					
11	DHARSHAN	18	M	19	1	72	124	78	93.33	78	72	68	74	69	66	64	70						
12	SUBRAMANI	68	M	25	2	74	138	88	104.67	79	85	74	72	68	64	66	70	68	74	72			
13	VARADHARAJAN	39	M	23	1	92	132	92	105.33	106	102	98	92	106	94	92	94	102	112				
14	MYMUNISHA	65	F	27	2	84	142	84	103.33	84	82	90	82	78	74	80							
15	PRATHAP	28	M	23	1	74	124	74	90.67	78	82	74	70	72	68	62	64	69	72	70			
16	RAJ KUMAR	24	M	24	1	72	118	82	94	78	74	68	62	58	62	64	68	78	68	64	62		
17	PUNITHA	47	F	29	2	97	144	82	102.67	108	102	98	108	112	104	96	92	84	88				
18	NEELIMA	22	F	23	1	74	128	76	93.33	80	82	74	72	76	69	72	78						
19	SABARISH	29	M	27	1	80	132	86	101.33	88	82	88	78	76	72	74	79	84					
20	MUTHAIYA	56	M	27	2	92	132	78	96	98	90	88	80	73	70	68							
21	MALINI	33	F	24	1	78	122	74	90	84	82	78	72	70	64	68	69	72					
22	RANGARAJ	64	M	26	2	82	130	82	98	92	98	102	92	84	80	78	82	90	84	90			
23	KUMARAVEL	31	M	19	1	74	114	64	80.67	78	72	68	68	74	72	68	74	78	72	70	78	72	
24	SENTHIL NATHAN	29	M	21	1	70	118	72	87.33	74	72	68	62	56	54	62	60	54	58	62	68	56	60
25	RAJA SUBRAMANI	24	M	23	1	78	124	82	96	80	82	74	72	68	70	68	74	64	68	62	70	70	
26	VAANI	29	F	29	1	98	144	88	106.67	108	112	108	100	98	92	88	84	86	82	90			
27	AMREEN	24	F	22	1	80	120	82	94.67	88	82	80	78	72	68	72	70	76					
28	PRINCE	38	M	28	2	96	132	94	106.67	102	98	108	104	98	92	96	90	88	82				
29	BALA SUBRAMANI	45	M	27	1	84	134	88	103.33	92	96	92	88	82	84	78	72	78	76	72	78	72	80
30	JEEVA	39	M	24	1	78	122	82	95.33	82	88	80	72	78	70	68	74	72	78	70	68		

S.No	NAME	AGE	SEX	BMI	ASA	BASELINE VITALS				INTRA OP PULSE RATE												
						PR	SBP	DBP	MAP	0 MINS	5	10	15	30	45	60	75	90	105	120	135	150	165
GROUP B																						
1	PRATHAP KUMAR	28	M	21	1	78	114	68	83.33	82	80	74	72	70	64	68	70	72	68	78	80	
2	MURUGAN	40	M	22	2	74	126	78	94	80	82	74	72	70	68	74	72	70	76	76		
3	BACKYANATHAN	50	M	27	2	92	138	88	104.67	96	102	100	94	90	88	82	78	80	78	78		
4	POONGAVANAM	22	F	21	1	71	114	70	84.67	78	80	72	70	68	62	64	69	70				
5	NIRMALA	35	F	26	1	78	132	86	101.33	88	84	80	80	78	72	76	80	82	82	86	90	92	96
6	ANITHA	25	F	23	1	84	122	80	94	82	89	80	78	72	70	68	70	72	74			
7	RAJA	48	M	27	2	92	138	84	102	96	90	88	80	90	82	80	78	80	84	88	80	78
8	CHINNAPONNU	67	F	21	2	76	118	70	86	82	74	78	70	68	62	60	60	64	69	70		
9	SATHISH	21	M	19	1	80	122	82	95.33	84	80	78	74	76	72	70	68	70	72	76	74	76
10	ADHILAKSHMI	35	F	25	1	82	134	88	103.33	88	82	78	72	68	66	64	62	68	70			
11	MURALI	26	M	23	1	76	122	74	90	78	80	72	68	62	56	58	58	62	64			
12	SIVASEELAN	52	M	28	1	80	138	88	104.67	92	98	90	84	82	82	80						
13	SIVA	19	M	21	1	72	114	68	83.33	78	72	68	69	72	74	72	70	70	74			
14	ELANGOVAN	27	M	23	1	80	122	78	92.67	82	88	80	78	72	68	68	62	68	70	72		
15	GANDHI	18	M	27	1	74	138	86	103.33	78	72	72	68	76	74	68	66	70				
16	VELMURUGAN	24	M	21	1	72	130	78	95.33	76	80	72	68	62	62	64	68	62	69	70	72	68
17	SHANKAR	24	M	24	1	80	128	80	96	82	80	72	68	68	64	68	70	66	62	70	74	70
18	MURUGARAJ	28	M	23	1	82	124	82	96	88	80	78	72	76	70	68	64	66	70	72		
19	JULAIKARA BEE	68	F	22	2	88	122	72	88.67	90	82	80	76	72	68	64	66	68	62			
20	DINESH	21	M	22	1	76	118	72	87.33	76	72	68	62	56	58	62	68	64	69	70	72	74	68
21	SURESH	32	M	22	1	82	128	86	100	88	92	80	78	72	76	68	62	69	72	74		
22	MANISH	22	M	28	1	80	141	86	104.33	88	82	78	76	74	76	72	80	72	79			
23	DEEPA	31	F	23	1	76	124	74	90.67	78	76	72	68	66	64	72	76	71	69	64	66	
24	ROBERT	28	M	24	1	82	132	84	100	82	88	92	96	92	90	84	82	80	74	80	84	86	82
25	HARI KUMAR	37	M	25	1	71	118	74	88.67	70	74	70	68	64	62	56	58	59	61	62		
26	NAGARAJ	43	M	24	1	78	128	82	97.33	82	88	84	78	72	78	80	84	86				
27	PERIYAN	65	M	25	2	86	138	92	107.33	90	92	88	84	88	82	90	86	80	75	76	82	
28	MEENAKSHI	56	F	27	2	88	136	82	100	92	90	84	88	80	78	76	80	81	86			
29	KUMARAVEL	27	M	20	1	74	118	74	88.67	78	82	80	76	72	68	66	62	70	72	80	72	72
30	TAMBI DURAI	42	M	23	1	88	134	86	102	96	92	88	86	90	82	78	80	82	88			

	INTRA OP SBP															INTRA OP DBP									
180	0 MINS	5	10	15	30	45	60	75	90	105	120	135	150	165	180	0 MINS	5	10	15	30	45	60	75	90	105
	148	138	141	130	129	122	118	110	120	119	112	122	118			104	98	102	98	92	82	74	76	72	79
	124	128	122	120	115	104	110	102	110	108						94	100	92	84	72	68	70	76	71	69
	148	144	140	138	124	118	120	128	114	118	126					96	102	98	88	78	72	74	70	76	71
	131	122	124	120	118	116	126	124	110							88	82	76	80	74	76	72	69	70	
	118	126	120	116	110	108	110	119	104	109						76	79	72	70	69	66	70	74	77	72
99	130	126	128	118	116	120	110	108	102	106	96	98	94	99	102	80	78	74	76	72	69	66	64	69	62
	142	144	136	130	126	122	124	120	112							84	90	88	82	88	78	75	74	74	
	120	116	112	108	106	102	110	114								74	78	72	80	74	72	68	72		
	138	136	132	128	122	118	112	118	124	130	128					88	92	80	78	72	74	76	78	72	84
	142	146	134	128	134	136	132	124	130							98	102	98	96	88	84	82	80	78	
	126	130	122	114	118	110	108	114								82	74	76	72	68	70	74	72		
	146	142	134	130	122	124	128	120	118	124	122					88	96	92	84	80	74	78	72	80	76
	134	142	144	148	134	132	126	130	134	140						92	96	102	98	92	88	94	86	82	94
	144	148	138	134	130	123	128									92	94	88	84	82	80	90			
	128	134	122	118	112	108	110	114	119	114	108					78	82	84	74	70	76	72	70	76	72
	124	122	118	119	120	114	108	109	116	112	124	128				80	78	82	84	74	76	72	80	78	76
	148	142	146	138	140	132	136	128	136	128						88	92	94	84	80	86	78	82	86	80
	124	132	130	128	122	118	114	120								78	86	82	78	74	72	76	78		
	140	138	132	128	122	120	126	122	128							86	82	78	72	76	79	84	78	82	
	138	124	122	120	129	134	136									78	72	68	70	74	78	84			
	124	128	120	118	114	110	122	118	120							84	82	78	74	68	74	70	69	68	
	138	142	136	132	128	122	118	124	128	134	138					80	88	80	74	78	68	76	72	78	82
	114	120	112	110	108	102	106	98	102	104	96	98	108			80	78	74	68	72	64	62	60	64	68
64	122	126	118	110	112	114	108	102	109	112	116	114	108	114	112	82	78	74	68	66	64	68	69	70	72
	124	128	130	122	118	112	114	116	110	112	118	108	109			82	88	80	78	72	74	70	68	64	62
	148	152	142	138	132	128	122	127	128	134	128					92	98	102	96	92	84	92	90	88	86
	122	124	118	112	116	110	108	109	112							82	80	74	72	68	64	68	72	70	
	134	140	138	132	128	126	122	129	130	128						92	90	88	88	82	86	92	84	82	80
	138	132	128	122	118	118	116	112	110	109	117	116	122	120		84	82	78	72	74	70	68	72	70	69
	128	132	130	128	122	120	118	119	120	111	120	118				80	78	74	80	72	70	68	74	72	82

	INTRA OP SBP															INTRA OP DBP									
180	0 MINS	5	10	15	30	45	60	75	90	105	120	135	150	165	180	0 MINS	5	10	15	30	45	60	75	90	105
	128	122	124	120	116	114	110	108	102	110	116	124				82	76	68	72	70	69	72	66	68	72
	120	132	124	122	118	110	112	114	116	110	108					84	82	84	78	74	72	68	70	72	76
	142	144	138	132	134	128	122	129	120	126	132					96	92	88	86	82	78	72	76	80	72
	118	112	104	100	102	108	112	106	102							74	78	72	68	64	69	74	72	72	
90	134	139	140	134	128	122	128	122	120	116	118	110	114	112	116	84	88	82	78	74	72	68	70	70	66
	128	122	120	116	118	113	117	110	118	120						86	82	78	78	72	68	70	69	74	68
	142	144	138	132	134	130	128	130	136	138	130	129	138			96	102	100	98	92	88	86	84	89	82
	114	118	120	112	108	102	104	108	114	112	110					76	72	72	68	64	66	62	68	68	72
	124	126	122	118	112	110	108	112	116	108	114	116	120			82	88	80	78	72	74	72	70	68	68
	138	134	134	128	122	120	116	112	118	110						92	88	84	80	78	70	72	74	76	79
	122	129	120	114	116	110	108	110	112	110						80	74	72	68	64	66	70	72	68	66
	142	138	140	134	130	130	136									92	94	88	82	86	80	82			
	124	128	122	118	110	110	116	114	108	112						82	84	78	72	70	68	66	70	73	74
	130	132	128	122	120	118	116	112	119	122	127					80	82	78	72	76	74	73	70	68	70
	140	142	138	134	128	130	129	122	126							90	88	84	82	78	72	70	76	80	
	130	128	122	124	120	118	116	112	114	118	116	110	120			80	78	78	72	68	66	72	74	68	68
	130	128	122	118	120	116	114	110	116	114	120	121	124			82	80	78	76	70	68	72	74	76	76
	128	122	120	118	114	116	110	108	109	115	120					80	82	78	72	68	66	68	74	69	70
	126	122	120	116	118	112	112	104	108	116						80	74	68	62	64	66	69	64	70	68
	122	118	116	112	110	122	124	118	110	108	106	108	114	116		78	80	72	68	72	74	76	70	68	70
	136	132	129	127	124	118	110	112	119	124	121					84	78	82	76	76	72	74	68	76	74
	138	146	132	136	130	128	126	122	129	132						89	91	88	84	86	82	78	80	76	80
	129	130	124	122	120	116	110	118	112	106	109	111				80	78	76	72	70	74	68	72	78	70
	134	138	141	144	142	138	134	128	127	128	131	136	134	139		86	92	90	94	82	84	82	78	84	83
	118	124	122	120	116	114	112	110	108	108	114					74	78	72	70	68	69	64	66	62	62
	128	134	132	130	126	124	128	130	124							78	82	76	72	78	70	68	70	72	
	142	144	138	138	134	128	130	126	134	138	140	144				88	92	96	88	84	86	82	78	76	80
	140	136	138	132	128	126	124	120	119	131						88	82	80	78	76	72	80	80	76	74
	124	122	118	114	110	108	106	108	114	116	120	122	126			82	74	78	72	68	69	64	71	72	69
	145	146	142	138	132	126	132	128	122	129						89	92	88	84	86	82	78	82	76	79

					INTRA OP MAP														
120	**135**	**150**	**165**	**180**	**0 MINS**	**5**	**10**	**15**	**30**	**45**	**60**	**75**	**90**	**105**	**120**	**135**	**150**	**165**	**180**
69	70	74			118.7	111.33	115	108.67	104.33	95.333	88.67	87.33	88	92.33	83.33	87.33	88.67		
					104	109.33	102	96	86.33	80	83.33	84.67	84	82					
70					113.33	116	112	104.67	93.33	87.33	89.33	89.33	88.7	86.67	88.67				
					102.33	95.33	92	93.33	88.67	89.33	90	87.33	83.33						
					90	94.67	88	85.33	82.67	80	83.33	89	86	84.33					
56	60	54	64	62	96.67	94	92	90	86.67	86	80.67	78.67	80	76.67	69.33	72.67	67.33	75.67	75.33
					103.33	108	104	98	100.67	92.67	91.33	89.33	86.67						
					89.33	90.67	85.33	89.33	84.67	82	82	86							
88					104.67	106.67	97.33	94.67	88.67	88.67	88	91.33	89.33	99.33	101.33				
					112.67	116.67	110	106.67	103.33	101.33	98.67	94.67	95.33						
					96.67	92.67	91.33	86	84.67	83.33	85.33	86							
80					107.33	111.33	106	99.33	94	90.67	94.67	88	92.67	92	94				
					106	111.33	116	114.67	106	102.67	104.67	100.67	99.33	109.33					
					109.33	112	104.67	100.67	98	94.33	102.67								
79					94.67	99.33	96.67	88.67	84	86.67	84.67	84.67	90.33	86.00	88.67				
78	74				94.67	92.67	94	95.67	89.33	88.67	84	89.67	90.67	88	93.33	92			
					108	108.67	111.33	102	100	101.33	97.33	97.33	102.67	96					
					93.33	101.33	98	94.67	90	87.33	88.67	92							
					104	100.67	96	90.67	91.33	92.67	98	92.67	97.33						
					98	89.33	86	86.67	92.33	96.67	101.33								
					97.33	97.33	92	88.67	83.33	86	87.33	85.33	85.33						
88					99.33	106	98.67	93.33	94.67	86	90	89.33	94.67	99.33	104.67				
72	66	70			91.33	92	86.67	82	84	76.67	76.67	72.67	76.67	80	80	76.67	82.67		
68	68	70	72	76	95.33	94	88.67	82	81.33	80.67	81.33	80	83	85.33	84	83.33	82.67	86	88
69	72	70			96	101.33	96.67	92.67	87.33	86.67	84.67	84	79.33	78.67	85.33	84	83		
92					110.67	116	115.33	110	105.33	98.67	102	102.33	101.33	102	104				
					95.33	94.67	88.67	85.33	84	79.33	81.33	84.33	84						
					106	106.67	104.67	102.67	97.33	99.33	102	99	98	96					
74	70	68	72		102	98.67	94.67	88.67	88.67	86	84	85.33	83.33	82.33	88.33	85.33	86	88	
84	78				96	96	92.67	96	88.67	86.67	84.67	89	88	91.67	96	91.33			

					INTRA OP MAP														
120	**135**	**150**	**165**	**180**	**0 MINS**	**5**	**10**	**15**	**30**	**45**	**60**	**75**	**90**	**105**	**120**	**135**	**150**	**165**	**180**
74	78				97.33	91.33	86.67	88	85.33	84	84.67	80	79.33	84.67	88	93.33			
79					96	98.67	97.33	92.67	88.67	84.67	82.67	84.67	86.67	87.33	88.67				
74					111.33	109.33	104.67	101.33	99.33	94.67	88.67	93.67	93.33	90	93.33				
					88.67	89.33	82.67	78.67	76.67	82	86.67	83.33	82						
70	62	64	62	68	100.67	105	101.33	96.67	92	88.67	88	87.33	86.67	82.67	86	78	80.67	78.67	84
					100	95.33	92	90.67	87.33	83	85.67	82.67	88.67	85.33					
90	90	94			111.33	116	112.67	109.33	106	102	100	99.33	104.67	100.67	103.33	103	108.67		
70					88.67	87.33	88	82.67	78.67	78	76	81.33	83.33	85.33	83.33				
70	72	76			96	100.67	94	91.33	85.33	86	84	84	84	81.33	84.67	86.67	90.67		
					107.33	103.33	100.67	96	92.67	86.67	86.67	86.67	90	89.33					
					94	92.33	88	83.33	81.33	80.67	82.67	84.67	82.67	80.67					
					108.67	108.67	105.33	99.33	100.67	96.67	100								
					96	98.67	92.67	87.33	83.33	82	82.67	84.67	84.67	86.67					
72					96.67	98.67	94.67	88.67	90.67	88.67	87.33	84	85	87.33	90.33				
					106.67	106	102	99.33	94.67	91.33	89.67	91.33	95.33						
69	70	71			96.67	94.67	92.67	89.33	85.33	83.33	86.67	86.67	83.33	84.67	84.67	83.33	87.33		
78	74	72			98	96	92.67	90	86.67	84	86	86	89.33	88.67	92	89.67	89.33		
72					96	95.33	92	87.33	83.33	82.67	82	85.33	82.33	85	88				
					95.33	90	85.33	80	82	81.33	83.33	77.33	82.67	84					
72	70	69	66		92.67	92.67	86.67	82.67	84.67	90	92	86	82	82.67	83.33	82.67	84	82.67	
72					101.33	96	97.67	93	92	87.33	86	82.67	90.33	90.67	88.33				
					105.33	109.33	102.67	101.33	100.67	97.33	94	94	93.67	97.33					
70	72				96.33	95.33	92	88.67	86.67	88	82	87.33	89.33	82	83	85			
88	91	90	94		102	107.33	107	110.67	102	102	99.33	94.67	98.33	98	102.33	106	104.67	109	
68					88.67	93.33	88.67	86.67	84	84	80	80.67	77.33	77.33	83.33				
					94.67	99.33	94.67	91.33	94	88	88	90	89.33						
79	80				106	109.33	110	104.67	100.67	100	98	94	95.33	99.33	99.33	101.33			
					105.33	100	99.33	96	93.33	90	94.67	93.33	90.33	93.00					
64	70	71			96	90	91.33	86	82	82	78	83.33	86.00	84.67	82.67	87.33	89.33		
					107.67	110	106	102	101.33	96.67	96	97.33	91.33	95.67					

SENSORY		MOTOR		RESCUE ANALGESIA	QUALITY OF BLOCK	SIDE EFFECTS/ complication
ONSET	DURATION	ONSET	DURATION			
6	600	8	510		SATISFACTORY BLOCK	NO
9	720	11	690		SATISFACTORY BLOCK	NO
6	540	9	450		SATISFACTORY BLOCK	NO
7	660	8	630		SATISFACTORY BLOCK	NO
4	750	6	690		SATISFACTORY BLOCK	NO
8	510	10	450		SATISFACTORY BLOCK	NO
7	600	8	540		SATISFACTORY BLOCK	NO
5	780	8	750		SATISFACTORY BLOCK	NO
9	510	15	480		SATISFACTORY BLOCK	NO
6	660	9	630		SATISFACTORY BLOCK	NO
5	720	8	630		SATISFACTORY BLOCK	NO
9	510	15	450		SATISFACTORY BLOCK	NO
				converted to General Anaesthesia	UNSATISFACTORY BLOCK	NO
6	840	9	780		SATISFACTORY BLOCK	NO
6	690	10	600		SATISFACTORY BLOCK	NO
8	540	12	480		SATISFACTORY BLOCK	NO
				converted to General Anaesthesia	UNSATISFACTORY BLOCK	NO
5	600	9	540		SATISFACTORY BLOCK	NO
12	540	15	480		SATISFACTORY BLOCK	NO
6	630	9	570		SATISFACTORY BLOCK	NO
9	450	12	390		SATISFACTORY BLOCK	NO
6	600	10	510		SATISFACTORY BLOCK	NO
4	660	6	600		SATISFACTORY BLOCK	NO
6	600	9	510		SATISFACTORY BLOCK	NO
9	570	12	510		SATISFACTORY BLOCK	NO
10	540	12	510		SATISFACTORY BLOCK	NO
8	600	10	570		SATISFACTORY BLOCK	NO
16	540	18	450		SATISFACTORY BLOCK	NO
8	600	10	540		SATISFACTORY BLOCK	NO
6	600	10	510		SATISFACTORY BLOCK	NO

SENSORY		MOTOR		RESCUE ANALGESIA	QUALITY OF BLOCK	SIDE EFFECTS/ complication
ONSET	DURATION	ONSET	DURATION			
7	810	10	780		SATISFACTORY BLOCK	NO
6	720	9	660		SATISFACTORY BLOCK	NO
4	780	6	750		SATISFACTORY BLOCK	NO
6	720	8	690		SATISFACTORY BLOCK	NO
8	630	15	570		SATISFACTORY BLOCK	NO
5	840	7	780		SATISFACTORY BLOCK	NO
6	750	8	690		SATISFACTORY BLOCK	NO
7	780	10	720		SATISFACTORY BLOCK	NO
5	780	8	750		SATISFACTORY BLOCK	NO
7	690	10	600		SATISFACTORY BLOCK	NO
4	1080	6	960		SATISFACTORY BLOCK	NO
6	690	8	630		SATISFACTORY BLOCK	NO
6	690	10	630		SATISFACTORY BLOCK	NO
8	750	12	690		SATISFACTORY BLOCK	NO
9	780	12	720		SATISFACTORY BLOCK	NO
5	720	8	660		SATISFACTORY BLOCK	NO
6	690	9	630		SATISFACTORY BLOCK	NO
6	750	9	690		SATISFACTORY BLOCK	NO
12	780	15	720		SATISFACTORY BLOCK	NO
6	720	8	600		SATISFACTORY BLOCK	**NO**
7	690	10	630		SATISFACTORY BLOCK	NO
9	660	12	570		SATISFACTORY BLOCK	NO
5	780	8	750		SATISFACTORY BLOCK	NO
				converted to General Anaesthesia	UNSATISFACTORY BLOCK	NO
6	720	8	660		SATISFACTORY BLOCK	NO
8	660	10	600		SATISFACTORY BLOCK	NO
5	540	9	510		SATISFACTORY BLOCK	NO
6	720	10	630		SATISFACTORY BLOCK	NO
6	780	8	690		SATISFACTORY BLOCK	NO
8	690	10	600		SATISFACTORY BLOCK	NO